FRUITS & NUTS EAST

FUNGICIDE BENEFITS ASSESSMENT

National Agricultural Pesticide Impact Assessment Program (NAPIAP)

FUNGICIDE BENEFITS ASSESSMENT

FRUIT AND NUT CROPS - EAST

January, 1991

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This Report Represents a Portion of the USDA/States
National Agricultural Pesticide Impact Assessment Program (NAPIAP)
Fungicide Assessment Project

Agricultural Benefits of Fungicides on Fruit and Nut Crops
Grown in the Eastern United States

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PREFACE

Plant diseases affect all the major food crops world-wide and must be controlled to prevent significant production losses and maintain food quality for animals and humans. In addition, fungicides are a necessary factor in maintaining the availability of fiber and landscape improvements ranging from forest management to enhancements through the use of ornamentals. Agricultural fungicides are a significant component in effective disease control and are critical to plant health management systems. Fungicides provide benefits to producers as well as consumers and to local as well as national economies. Farmers benefit from the prevention of yield losses, improved crop quality, enhanced market opportunities, facilitation of farmwork and harvest. Consumers also benefit from an ample, varied, safe, healthy and inexpensive food supply that is available throughout the year.

This is one of 11 separate reports that assessed the beneficial aspects of fungicide use in U.S. agriculture. The 11 reports, all using a commodity approach in evaluating fungicide use, comprise the Fungicide Benefits Assessment. This assessment represents one part of the USDA/States National Agricultural Pesticide Impact Assessment Program's Fungicide Assessment Project. The two other parts deal with (a.) a treatise examining the health and environmental factors associated with the agricultural use of fungicides, and (b.) an assessment of the status as well as the management strategies for fungal resistance to fungicides in the U.S.

The 11 Fungicide Benefits Assessment reports were prepared by a team of scientists (team leaders). The team leaders and the listing of their reports (by commodity) in the Fungicide Benefits Assessment are as follows:

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AGRICULTURAL BENEFITS OF FUNGICIDES USED ON FRUIT AND NUT CROPS GROWN IN THE EASTERN UNITED STATES

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Executive Summary

The commercial production of deciduous fruits and nuts in the U. S. comprises 3.37 million acres planted in various regions with an annual value of approximately $6.5 billion. This report shows the relative importance and usage patterns of the fungicides registered and most commonly used on 12 deciduous fruit crops and pecans grown in regions east of the Mississippi River. Fruit and nut crops are susceptible to several hundred disease, insect, animal, and weed pests which require some level of control to prevent significant losses. Growers of these crops are very dependent on the use of agrichemicals to manage pests within economic injury levels. In addition to the efficient use and timely application of pesticides, several other control measures are used to keep pest damage to a low level including resistant cultivars, proper fertilization, and vegetation control in orchards. The establishment of action thresholds and the use of a number of factors affecting the level of control are often integrated together into a management system known as Integrated Crop Management (ICM).

ICM programs have been used rather extensively in apple growing regions for more than two decades to minimize pesticide usage while maintaining adequate pest control. Evidence of the effectiveness of an ICM approach in reducing fungicide and insecticide rates in apple orchards was shown for 20 apple growers in Pennsylvania in 1978 and 1979. Fungicides and insecticides were used at 40% below recommended amounts in standard programs. Because disease complexes vary with climatic regions and cultivars grown, specific integrated crop management systems and fungicide rates must vary to match specific conditions. Variations in disease incidence and degree of difficulty in maintaining them below economic levels are commonly found among the fruit and nut crops. The development of pathogen strains which are tolerant to some fungicides such as the benzimidazoles or dicarboximides has presented major difficulties in maintaining control above economic injury levels.

Diseases caused by fungal pathogens infecting the various fruit crops and pecans are extremely varied and often specific for each crop. Details of the usage pattern for the commonly used fungicides are

provided in each of the crop sections. The following is a brief summary for each crop.

- **Apple** - In the U. S. 468,010 acres are grown with an annual production of 210 million bushels valued at $1.2 billion annually. Approximately half of the production is grown in eastern states with 60% of the eastern crop being utilized as fresh. Ten to 20 fungal diseases commonly affect apple leaves or fruit, ten of which require annual usage of fungicides to control. Disease incidence varies from 2.0% (black pox) to 100% (scab) of the acreage affected with the potential loss of from 5.0% (Botrytis blossom-end rot) to 90% (scab, bitter rot, sooty blotch) where the diseases occur if no control measures are used. Apple scab is the most common disease and fungicide selection and usage is governed by its severity. Usage patterns for 21 fungicides or bactericides are given.
- **Blueberry** - Commercial production of blueberries is found in 14 states on an estimated 47,550 acres and valued at $157 million annually. More than 95% of the blueberry crop is grown in eastern states with 92% grown in Michigan, Massachusetts, and New Jersey. Five or more diseases widely affect 30% to 90% of the commercial acreage. Yield losses may be 25% to 60% if not controlled. Protective fungicides benomyl, captan, or their combinations are used on 50% to 70% of the acreage in 2-4 applications annually. Triforine is also commonly used in early sprays on as much as 65% of the acreage.

  Caneberries are grown throughout the U. S. in relatively small plantings. Estimates of acreage range from 10,000 to 20,000 acres with about equal amounts in the northeast, northcentral, and western regions. Raspberries are grown most commonly as a commercial crop (11,500 acres) followed by blackberries (7,650 acres). Five to seven diseases require fungicides for control. Anthracnose occurs on 60% to 70% of the acreage with losses of up to 100% if not controlled. Benomyl, captan, and vinclozolin are most commonly used for control of fruit decay, while calcium polysulfide is used extensively for control of leaf and cane diseases. Metalaxyl is used in two applications annually for control of Phytophthora root rot on 40% of the acreage.
- **Cherries** - The national cherry crop is valued at $200 million annually. Although the acreage of both sweet and tart cherries are similar (47,100 acres of sweet and 47,810 of tart) 89% of the tart are grown in the eastern states of Michigan, New York, and Pennsylvania while 80% of the sweets are grown in the western states of Washington, Oregon, and California. Both cherry types are susceptible to five or more major fungal diseases. Brown rot occurs on 75% to 100% of the acreage and may cause 60% to 70% loss if no fungicide control measures are used. Protective fungicides such as captan, chlorothalonil, iprodione, and vinclozolin are used extensively for control of brown rot and cherry leafspot which may also cause from 80% to 100% yield losses. The sterol-inhibitor fungicides triforine and fenarimol are being used more commonly but are more effective when used in combination with protective fungicides.

- **Cranberry** production is a highly specialized crop, 91% of which is grown in Massachusetts (46%), Wisconsin (32%) and New Jersey (13%). The U. S. production is 4.0 million barrels,valued at $178.9 million and grown on 25,000 acres of bogs. At least eight fungal pathogens cause losses from 25% to 100% if not controlled through the use of 2-3 fungicide applications annually. Chlorothalonil is used on 75% of the acreage while mancozeb is used on 40% of the acreage. Both ferbam and copper fungicides are used on 25% of the acreage. Control measures such as sanding of bogs and planting resistant cultivars are used in conjunction with fungicide sprays.
- **Grapes** are perhaps the most commonly grown fruit crop in all regions of the U. S. with commercial production in at least 17 states with over 757,000 acres valued at $1.36 billion. California produced 86% of the national grape crop. Eastern states of New York, Michigan, and Pennsylvania grow about 8% of the acreage (57,700 acres). Five or six diseases occur widely, but diseases such as powdery mildew and bunch rot are prevalent in all producing regions affecting 30% to 100% of the acreage and producing losses from 45% to 60% if not controlled. Fungicides are used in 3-6 applications annually to control 5 or more fungal pathogens. Strains of the powdery mildew and bunch rot pathogens that are tolerant to the benzimidazole and sterol-inhibitor fungicides have developed in both eastern and western vineyards. Mancozeb, ferbam, and captan are effective and are used extensively in combination to delay tolerant strain development in vineyards.
- **Peach/Nectarine** production is the third most valued noncitrus fruit crop produced on 190,100 acres and valued at $474 million. They are grown commercially in 21 eastern states on 105,800 acres and in six western states on 84,300 acres. The eastern crop comprises 31% of the national production. California produces a major portion of the nectarine and clingstone peach crop grown in the U. S. Four to eight fungicide applications are used for disease control in eastern states. Brown rot blossom blight and/or fruit rot affects all orchards both east and west and may produce losses of 75% to 90% if not controlled. Peach scab affects 50% to 100% of the acreage in the eastern states with potential losses of 50%. Two major bacterial diseases in addition to 6-7 major fungal pathogens require chemical applications for their control. Fifteen fungicides are used for control of these diseases. Protective fungicides captan, ferbam, and sulfur are commonly used in combination with the benzimidazole or dicarboximide fungicides for prevention of development of tolerant strains of the brown rot or peach scab pathogens. Orchard and packing house sanitation used in combination with post-harvest dips are effective in reducing losses due to brown rot and Rhizopus rot on harvested fruit.
- **Pears** - The commercial production of pears is centered in the western states of California, Oregon, and Washington where 90% of 69,600 acres valued at $234 million are grown. Most of the 5,800 acres grown in the east are in Michigan, New York, and

Pennsylvania. Four or five fungal pathogens require fungicide applications for control. Ferbam, ziram, fenarimol, or a combination of benomyl with ferbam or ziram are the fungicides most commonly used on pears. Fireblight, a bacterial disease, is very difficult to control and in the southern regions it is the most limiting factor to pear production. Losses are kept to a moderate level through the use of selective cultivars, good cultural practices, applications of a copper fungicide during the early season and blossom sprays of streptomycin.

. **Plums and Prunes** are grown in many states of the U. S., but the major commercial producing area is in the western states of California, Oregon, Washington, and Idaho. California produces 88% of the 125,600 acres grown which consist of 40,000 acres of plums, and 75,800 of prunes. Nationally, these crops are valued at more than $280 million annually. Both plum and prune cultivars are susceptible to seven fungal diseases which require annual applications of fungicides for control. Brown rot is a major disease that requires fungicide usage during the blossoming and harvesting periods to avoid economic losses. Black knot is also a very important fungal disease that destroys twigs and branches if not treated with fungicide applications. The fungicides most commonly used on these crops are benomyl, captan, iprodione, and triforine.

. **Strawberries** are widely grown throughout the U. S. in home and commercial plantings. Although acreage and production statistics are not well recorded, the national production is estimated at 55,000 acres valued at $1.2 billion. Major producing regions for fresh consumption are in California and Florida, but strawberries are grown commercially for fresh and processing in at least 20 states with about equal production in eastern and western regions. In the eastern region, acreage is estimated at 14,800 acres in 11 southeastern states; 9,500 in six northcentral states; and 5,600 acres in five northeastern states. Strawberry growers suffer commercial losses from 10 or more fungal diseases in all growing regions. Botrytis fruit rot is the most destructive affecting 100% of the acreage with 45% potential losses if not controlled. Fungicide applications along with annual renovation of beds, planting on raised beds, and controlling irrigation duration and rates are integrated into effective control programs for control of the disease complex present. Protective fungicides such as captan, benomyl, and vinclozolin are most commonly used, but others such as thiram, ziram, copper, and thiophanate methyl are registered for use.

. **Pecans** are grown in most southeastern and southwestern states and commercial production is reported in at least 11 states. Estimated acreage is 446,000 acres with annual production of 278.8 million pounds valued at $165 million. Pecan trees are affected by seven or eight fungal diseases which require fungicides for control. Approximately 80% of all acreage is treated with five to seven fungicide applications annually. Pecan scab is the most important disease affecting all commercial plantings with the potential of 80% loss. The fungicides most commonly used include

triphenyltin hydroxide, benomyl, dodine, fenarimol, and propiconizol.

Conclusions - The twelve deciduous fruit crops and pecans (planted nut crop) grown commercially in the states east of the Mississippi River require annual fungicide applications for control of the disease complexes affecting each crop. Each crop is affected with 6 to 12 major diseases which cause economic losses each year if not controlled. Fungicides used in from four to 10 applications are essential for control because effective biological control is unknown. Growers have quickly adopted Integrated Crop Management strategies in order to reduce fungicidal usage and efforts are continuing to use the minimum amount necessary.

Strains of some pathogens which are tolerant to the benzimidazole and dicarboximide fungicides have developed in some plantings. The management of pathogen populations with a mixture of tolerant and sensitive strains present special problems requiring for adequate control the tank-mixing, or alternating applications of chemically unrelated fungicides, or the limited usage of applications of the same fungicide. The sterol-biosynthesis inhibitor (SBI) fungicides are rapidly being adopted for commercial use. Tolerant strain development is the greatest threat to the future use of these fungicides. It is extremely important that fruit and nut growers have an extensive number of registered fungicides for use in each of these crops because of the wide range of pathogen types. No fungicide presently registered has sufficient breadth of activity to control the entire disease complex. Because of the high potential for tolerant strain development, major efforts must be taken by growers to use appropriate control strategies that will avoid such development. The protective fungicides such as captan, mancozeb, and metiram have been very effective in providing control without tolerant strain development. Special efforts are under way to reregister these fungicides which are very important for use as companion fungicides with the SBI compounds.

FUNGICIDES USED ON FRUIT AND NUT CROPS
in the Eastern United States

Successful commercial production of fruit and nut crops in the United States requires a high level of horticultural skills and thorough knowledge of the most advanced tactics for managing pests. Because fresh fruit consumers prefer attractive high quality produce and processors must adhere to high standards of fruit quality, growers of fruits and nuts have become dependent on the extensive use of pesticides to control the hundreds of insects, diseases, animals, and weed pests affecting their crops. The objective of this report is to show the relative importance and usage patterns of the fungicides registered and most commonly used on 12 deciduous and 1 planted nut crop grown in states east of the Mississippi river. Similar information is being published in a separate report for fruit and nut crops in producing areas of the western states. Efforts have not been made to include all registered brand names of specific fungicides and specific trade names were selected only to illustrate the availability of the fungicide. It is recognized that many of the registered fungicides have variable formulations and usage patterns that may differ from those listed in this report.

Importance of Fruit and Nut Crops

The production of deciduous fruits and nut crops in the United States is a significant contribution to the national food production consisting of 3.37 million acres (1.36 million hectares) with an annual value of approximately $6.5 billion. The leading 12 deciduous tree and small fruit (soft fruit) crops are valued at $5.25 billion and produced on 1.85 million acres (0.75 million hectares). The planted nut crops are grown on 670,000 acres and valued at $915 million annually. Details of production and values of each crop are given in the specific crop sections.

Crop Production Regions

The major fruit and nut crops grown commercially in the United States are produced in regions where specific climatic conditions are favorable for the specific crop. Although specific climatic conditions favor the successful and profitable production of fruit, other factors such as favorable soil type, nearness to markets, and availability of the necessary support services, labor, and products are equally important. Deciduous tree and small fruits are grown in essentially all 48 contiguous states of the U.S. with major commercial producing regions located along the east and west coasts and in the northcentral and northeastern states. Citrus crops are limited to specific regions in California, Florida, and Texas, while most of the commercial production of planted nuts is in California and in seven southeastern and

southwestern states. Deciduous and nut crops are grown in both humid and arid climates and are often limited by the prevailing temperatures during the winter months, incidence of spring frost during the blossoming period, and the availability of sufficient rainfall or irrigation water for adequate yield production and fruit size.

Disease Management Tactics

Cultivars of fruit and nut crops grown commercially in the U. S. are affected by several hundred disease, insect, animal, or weed pests which require some level of control to prevent significant losses. Descriptions and general control measures for many of these diseases are given in Compendia of Diseases affecting apple and pear, grapes, and strawberries published by APS Press, the American Phytopathological Society or in Extension Bulletins published by Cooperative Extension in various states. Although control measures, such as resistant cultivars or rootstocks and specific cultural practices are used extensively to avoid build-up of pest populations, agricultural chemicals such as pesticides, fertilizers, and growth regulators are required to maintain pest levels below economic injury thresholds. Many insect, disease, and weed pests are maintained by applying appropriate pesticides at action thresholds previously established through research for each pest and crop that allows a minimum pesticide usage while maintaining control of the pest. The establishing of such action thresholds and the use of a number of factors affecting the level of control are often integrated together into a management system used by growers.

This integrated pest management (IPM) approach has more recently been referred to as Integrated Crop Management (ICM), or Sustainable Agriculture but has been in practice by some growers for more than two decades. Evidence of the effectiveness of an ICM approach in reducing fungicide and insecticide rates in apple orchards was shown by Hull and Hickey (1983) for 20 apple growers in Pennsylvania surveyed in 1978 and 1979. The amount of insecticides and fungicides used by the growers who were picked at random from among 281 growers in a three county area in southcentral Pennsylvania (61% of PA growers) was 40% below recommended amounts in standard programs.

The integrated approach for disease control on many of the fruit crops utilizes knowledge of requirements for disease infection, stages when leaves and fruit are susceptible, availability of inoculum, and many other factors affecting the development of epidemics in orchards or on harvested fruits. Such an approach for disease control in apple orchards has been offered by Gadoury, et al (1989) for the northeastern states. Because disease complexes vary with climatic regions and cultivars grown, specific integrated crop management systems and fungicide type and rates must vary to match specific conditions. In eastern states, for example, apples are grown in many states from Maine to Georgia where temperatures and the number and type of fungal pathogens varies widely. Apple scab is the major disease of concern to growers in Maine, while scab is only a minor problem in the Carolinas and Georgia. Other fungal pathogens which are major decay producers in

apple in the warmer southern climates are seldom a problem in the cooler northeast.

Variations in disease incidence and degree of difficulty in maintaining them below economic levels are commonly found among the fruit and nut crops. The number of applications and rate of fungicides used has out of necessity varied from region to region and crop to crop. Orchardists have continually sought new approaches such as improved application methods to increase efficiency of fungicide usage or have adopted new fungicides swiftly in hope of reducing costs or improving control.

Development of Tolerant Strains - A Major Concern

The development of pathogen strains which are tolerant to some fungicides such as the benzimidazoles or dicarboximides has presented major difficulties in maintaining control above economic injury levels at costs affordable by growers. Research findings suggesting approaches to avoid tolerant strain development, such as reduced number of applications per year of the "at risk" fungicides, use of fungicide combinations, or limited selective "block time usage" have been quickly adopted by growers of most of the fruit and nut crops.

The combination of fungicides with different modes of action against specific pathogens has been internationally recognized as an effective deterrent of tolerant strain development in many crops. Fruitgrowers first recognized the value of this tactic when faced with pathogens that became tolerant to the benzimidazoles about 20 years ago. The tank mixing of these fungicides with the EBDC fungicides or captan (protective fungicides) has been very successful in delaying tolerant strain development, especially when the number of benzimidazole applications were limited to three annually. Similar combinations of the protective fungicides with the sterol biosynthesis inhibitor fungicides (SBI) (triadimefon, fenarimol, and myclobutanil) have improved efficacy of both fungicide types with lower rates of each and have decreased the risk of tolerant strain development to the SBI fungicides. It is especially important that tolerance to the SBI fungicides be avoided because effective biological controls are unknown and previously available effective fungicides are rapidly becoming unavailable through loss of registration. The development of effective fungicides with modes of action different from the SBI's has been extremely slow during the past decade. It is not likely that new fungicides will become available for grower use in the near future that could effectively replace those presently registered. The availability of a number of fungicides with different modes of action will increase the probability of continual success in maintaining disease control in fruit and nut crops.

Fungicide Benefits Reports

Each of the leading fruit and nut crops grown in the eastern states

are plagued with eight or more fungal pathogens that are economically controlled through the use of annual fungicide programs. The specific fungicide, rate, and number of applications varies with the need in each orchard. Listed in the following crop sections are the fungicides and their usage patterns for control of the diseases for which they are registered. Estimates of the number of acres treated with each fungicide and the number of applications commonly used per year are given. Likewise, the percentage of the crop acreage affected by each of the diseases listed and the percent yield loss that would result if no control measures were taken is listed for each crop.

Each of the estimated values in these reports was derived through the assistance of the scientific advisors which made up the fruit and nut subcommittee. All of these persons are plant pathologists in land grant universities who are very familiar with the crops grown in the area in which they are employed. Additionally, persons employed as pest management consultants for fruit growers in each of the regions contributed their knowledge of disease incidence and fungicide usage. Acreage and production figures presented in the Tables were taken from the 1988 Summary for Noncitrus Fruits and Nuts published by the USDA National Agricultural Statistical Service. Some crop acreage statistics have been slightly modified based on more recent survey data.

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Fungicide Benefits on APPLE (*Malus domestica*)

Apple is a significant commercial crop grown in all regions of the United States on 468,010 acres with an annual production of 210 million bushels (8.82 billion pounds) and valued at $1.2 billion or 30% of the value of all noncitrus fruits (Table 1). More than 50 cultivars are grown, but the bulk of the production is limited to 8 to 10 with 'Delicious' accounting for approximately 1/3 of the production. Apple cultivars vary considerably in their susceptibility to approximately 20 fungal pathogens, 10 of which require fungicide usage for control in eastern apple growing regions.

Approximately 1/2 of the U. S. apple crop is produced in seven western states, 90% of which is produced in Washington and California (105,200 bu). Diseases of major concern in this region are post-harvest fruit rots and powdery mildew, caused by fungal pathogens, and fireblight caused by the bacterium (*Erwinia amylovora*). Thirty percent of the national production is in 11 northcentral and 7 northeastern states. In these regions, four or five diseases occur commonly, but apple scab (*Venturia inaequalis*) occurs in all orchards and can cause 90% loss if not controlled by fungicide sprays. Ten mid-Atlantic and southeastern states produce approximately 20% of the crop under environmental conditions highly favorable for 10 or more fungal diseases that can produce losses of from 60% to 90% if not controlled. Among the important fungal pathogens are five that produce fruit decay, four that produce fruit blemishes, three apple rusts, apple scab and powdery mildew. Fireblight, a bacterial pathogen, is more severe in this region because of higher rainfall and temperatures.

Control of the major diseases in commercial orchards is dependent upon the timely application of fungicides and bactericides usually applied as dilute or concentrate sprays with air delivery sprayers. The rate and number of applications varies with disease intensity and environmental conditions. In regions where apple scab is severe, control is maintained by applying protective fungicides such as captan, ferbam, mancozeb, thiram, and ziram used alone or in combination with dodine, benzimidazoles (benomyl, thiophanate methyl), or sterol-biosynthesis inhibitor (SBI) fungicides (fenarimol, myclobutanil). Captan or mancozeb are the protective fungicides most commonly used in combinations in managing fungicide tolerant pathogen populations or in preventing the development of tolerance in orchards. They are preferred because of their relatively high efficacy ratings even at concentrations reduced 40% to 50% of amounts registered for use alone. They also are the most efficacious against the pathogens causing fruit decay and limb cankers and in the mid-Atlantic and southeastern regions are used on 75% to 95% of the apple acreage treated. Integrated pest management tactics designed to minimize usage rates and number of applications are used in most apple orchards of the country. Post-infection control of apple scab is more feasible with the use of the SBI fungicides, but this method is limited by the need for thorough

coverage of all plant parts, short residual life of these fungicides, and the risk of significant increases in fungicide usage if specific post-infection applications fail to provide complete control. Fireblight and Phytophthora collar/crown rot are two highly destructive diseases which often result in complete loss of trees and have very limited registered materials for their control. Effective chemicals for control of these diseases are at risk because of potential resistance development and limited knowledge of biological control. Biological control methods for diseases affecting the above ground parts of apple trees is not presently feasible and little expectation for this approach is held for commercial orchards during the next decade.

The selection of alternative fungicides to replace those whose registration is in question is a complex matter because of the high diversity of the disease complex and the wide variation in mode of action and efficacy levels of many of the registered fungicides for apple. In addition to providing disease control, fungicides used on apples must be compatible with insecticides, acaricides, and bactericides which usually are tank mixed together to control other pests. Specifically, fungicides such as captan, diclon, dinocap, and sulfur are incompatible with spray oil used during the early season to improve control and prevent resistance development in mite populations. The relative efficacy levels against the more important diseases of apple is given in Table 2.

Table 1. Apple Bearing Acres and Production in the United States by Regions

State/Region	Bearing Acres - 1988	Production 42 lb bu (000) Mean 1984-1988
Northeast		
Connecticut	3,000	1,085
Maine	5,300	1,962
Massachusetts	7,400	2,267
New Hampshire	3,700	1,252
New York	61,000	22,857
Rhode Island	500	119
Vermont	4,500	1,086
Total	85,400	30,628
NorthCentral		
Arkansas	1,000	229
Illinois	6,800	2,257
Indiana	5,400	1,448
Iowa	1,300	207
Kansas	1,700	224
Kentucky	2,200	338
Michigan	53,500	21,190
Missouri	5,100	1,181
Minnesota	2,500	462
Ohio	8,700	2,928
Wisconsin	6,710	1,348
Total	94,910	31,812
Mid-Atlantic		
Delaware	1,000	547
Georgia	4,500	871
Maryland	4,600	1,624
New Jersey	6,000	2,191
North Carolina	11,500	7,119
Pennsylvania	27,000	13,143
South Carolina	4,500	829
Tennessee	1,700	288
Virginia	23,000	10,600
West Virginia	15,000	5,143
Total	98,800	42,355

West		
California	22,200	13,976
Colorado	5,000	1,824
Idaho	5,400	3,095
New Mexico	2,000	222
Oregon	9,000	3,667
Utah	3,300	1,162
Washington	142,000	81,238
Total	188,900	105,184
Total U.S.	468,010	209,979

Table 2. Efficacy of Fungicides Against Apple Diseases and Effect on Mites and Fruit Finish

Fungicides	Degree of Disease Control[1]									
	Scab	Powdery Mildew	Rusts	Black + White rot	Bitter rot	Blossom end rot (Botrytis)	Sooty blotch, Fly speck	Mite Suppression	Fruit finish[2]	Compatibility with spray oil
Benomyl[3]	1	2	5	3	5	2	1	3	3	yes
Captan	2	5	5	1	2	3	3	5	1	no
Dinocap	5	2	5	5	5	5	5	2	2	no
Dodine[3]	1	5	5	5	5	5	4	5	4	yes
Fenarimol	1	2	2	5	5	5	5	5	1	yes
Ferbam	3	5	2	2	4	4	2	5	4	yes
Mancozeb	2	5	2	1	1	2	1	4	1	yes
Metiram	2	5	2	1	1	2	1	4	1	yes
Myclobutanil	1	1	1	5	5	5	5	5	1	yes
Sulfur	4	3	4	4	4	4	4	4	4	no
Thiophanate methyl[3]	1	2	5	3	5	2	1	3	3	yes
Thiram	3	5	2	2	3	4	2	5	2	yes
Triadimefon	6	1	1	6	6	6	6	6	1	yes
Triforine	2	3	1	5	5	5	5	2	2	yes
Ziram	3	5	2	2	4	4	2	5	2	yes

[1] Degree of control under moderate to severe conditions: 1 = best, 2 = good, 3 = fair, 4 = slight, 5 = none, 6 = no registration
[2] Fruit finish on yellow cultivars: 1 = very good, 2 = good, 3 = fair, 4 = poor
[3] Tolerant strains of Venturia inaequalis (apple scab) have developed in many orchards

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 2,000 with 10-11 APPLICATIONS

62,100 with 3-5 APPLICATIONS

4. FUNGICIDE benomyl

a. Formulations: Benlate 50WP or 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Benlate 50DF 3.0-6.0 oz plus mancozeb fungicide 30-38 oz		
or		
Captan fungicide 18-32 oz	10-11	Green-tip thru 7th Cover
or		
Same as above	3-5	Tight-cluster thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bitter rot	Glomerella cingulata	14.0	90.0
Black rot	Botryosphaeria obtusa	25.0	60.0
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Fly speck	Zygophiala jamicensis	65.0	90.0 fresh
Powdery mildew	Podosphaera leucotricha	40.0	65.0
Quince rust	Gymnosporangium clavipes	50.0	60.0
Scab	Venturia inaequalis	100.0	90.0
Sooty blotch	Gloeodes pomigena	70.0	90.0 fresh 5.0 processed

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Scab and deformed = 95% loss
Fruit blemishes = 60% loss
Cankers = Loss proportional to limbs lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size

f. Alternative fungicides, formulations, rates:

thiophanate methyl - 11-16 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Apple scab resistance common in many fruit growing regions. Benomyl must be used in combination with captan, mancozeb, metiram, thiram, ziram to avoid resistance development. Limit application numbers to 3-5 per year.

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS: Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 55,820 with 9-10 APPLICATIONS

69,780 with 5-7 APPLICATIONS

4. FUNGICIDE captan

a. Formulations: Captan 50WP or 80WP; Captec 4F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Captan 50WP 3-4 lb	9-10	Green-tip thru 7th Cover
Captan 50WP 1.5-2 lb plus benomyl or SBI fungicides	5-7	Pre-bloom thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bitter rot	Glomerella cingulata	14.0	90.0
Black pox	Helminthosporium papulosum	2.0	20.0
Black rot	Botryosphaeria obtusa	25.0	60.0
Bot or white rot	Botryosphaeria dothidea	20.0	65.0
Botrytis blossom-end rot	Botrytis cinerea	12.0	5.0
Brooks fruit spot	Mycosphaerella pomi	5.0	10.0
Fly speck	Zygophiala jamicensis	65.0	90.0 fresh 5.0 processed
Scab	Venturia inaequalis	100.0	90.0
Sooty blotch	Gloeodes pomigena	70.0	90.0 fresh 5.0 processed

(1) Mathematical relationship between pest density an yield if known):

Decayed fruit = complete loss
Leaf spots = 2.5% loss unless there is severe defoliation
Cankers = Loss proportional to number of branches lost

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with annual pruning, weed control, and adequate water supply to trees.

f. Alternative fungicides, formulations, rates:
Mancozeb 80WP 38-102 oz ai/A (If available)
Thiram 65WP 60-84 oz ai/A - likely to be 25% less effective than captan

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to Captan known. Captan used as a companion fungicide with benomyl, fenarimol, dodine, myclobutanil, thiophanate methyl

b. Management practices using no chemical pesticides: Not likely to be able to grow apples commercially without pesticides

c. Diseases without adequate controls
Canker phase of black rot, white rot, Nectria, black pox

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 4,500 with 1-2 APPLICATIONS (fall or spring)

8,000 with 2 APPLICATIONS (bloom time)

4. FUNGICIDE copper

a. Formulations:
Kocide 101 77W (cupric hydroxide)
Kocide 606 37.5WP (cupric hydroxide)
COCS 50WP (from copper oxychloride and basic copper sulfate)

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Kocide 606 37.5WP 48-128 oz	1-2	fall or spring
or		
COCS 50WP 2.0 oz	2	during bloom

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Fireblight	Erwinia amylovora	60.0	85.0
Phytophthora collar/ crown rot	Phytophthora cactorum	7.0	75.0

(1) Mathematical relationship between pest density and yield (if known):

Death of trees = 70%-90% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is

necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Ridomil 2E 25EC 64-128 fl oz
streptomycin 17WP 100ppm

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to copper known for apple pathogens.

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 12,200 with 4-6 APPLICATIONS

4. FUNGICIDE dinocap

a. Formulations: Karathane WD 19.5WP, Karathane LC 37.4%

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Karathane WD 19.5WP 8-11 oz	4-6	Tight-cluster thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Powdery mildew	Podosphaera leucotricha	40.0	65.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size

f. Alternative fungicides, formulations, rates:

Bayleton 50W 1.0-4.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known to dinocap

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 12,000 with 3-5 APPLICATIONS

4. FUNGICIDE dodine

a. Formulations: Dodine 65WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Dodine 65WP 8-10 oz plus captan fungicide 18-32 oz or mancozeb fungicide 30-38 oz	3-5	Green-tip thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Scab	Venturia inaequalis	100.0	90.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Scab and deformed = 95% loss
Fruit blemishes = 60% loss
Cankers = Loss proportional to limbs lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size

f. Alternative fungicides, formulations, rates:
benomyl fungicide 3.0-6.0 oz ai/A plus protectant fungicide
sterol inhibitor fungicide plus protectant fungicide

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Apple scab resistance common in many fruit growing regions. Dodine must be used in combination with captan, mancozeb, thiram or ziram

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples without pesticides

c. Diseases without adequate controls:
Canker phase of black rot, white rot, nectria, black pox

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 130,000 with 2-3 APPLICATIONS

117,200 with 6-8 APPLICATIONS

4. FUNGICIDE fenarimol

a. Formulations: Rubigan 12.5EC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Rubigan 1E 0.75-1.5 oz	6-8	Green-tip thru 3rd Cover
or		
Rubigan 1E 0.5-0.75 oz plus captan, mancozeb, thiram, ziram	6-8	Green-tip thru 3rd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Powdery mildew	Podosphaera leucotricha	40.0	65.0
Scab	Venturia inaequalis	100.0	80.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size

f. Alternative fungicides, formulations, rates:
Nova 40WP 1.5-4.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known in apple pathogens, but the probability exists unless fenarimol is used in combination with unrelated fungicide such as captan, mancozeb, and dinocap.

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 60,000 with 1-3 APPLICATIONS

10,500 with 4 APPLICATIONS

4. FUNGICIDE ferbam

a. Formulations: Carbamate WDG 76WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Carbamate WDG 76WP 36-72 oz	1-3	1/2" green - 1st Cover
or		
Carbamate WDG 76WP 72-96 oz	4	2nd Cover thru 6th Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bitter rot	Glomerella cingulata	14.0	90.0
Black rot	Botryosphaeria obtusa	25.0	60.0
Brooks fruit spot	Mycosphaerella pomi	5.0	10.0
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Fly speck	Zygophiala jamicensis	65.0	90.0
Quince rust	Gymnosporangium clavipes	50.0	60.0
Scab	Venturia inaequalis	100.0	90.0
Sooty blotch	Gloeodes pomigena	70.0	90.0 fresh 5.0 processed

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size

f. Alternative fungicides, formulations, rates:

mancozeb 38-102 oz ai/A
captan 24-64 oz ai/A (Not effective against rust diseases)

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known to ferbam.

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples without pesticides.

c. Diseases without adequate controls:
Canker phase of black rot, white rot, nectria, black pox

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY Crabapple (Malus domestica)
Quince (Cydonia oblonga)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 27,900 with 10-11 APPLICATIONS

167,466 with 5-7 APPLICATIONS

4. FUNGICIDE mancozeb

a. Formulations:
Dithane M-45 80WP, Manzate 200 80DF, Dikar 77WP
Dithane F-45 37F, Dithane DF 75DF, Pencozeb 80WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Dithane M-45 80WP or Manzate 200 80DF 76-102 oz	10-11	Green-tip thru 7th Cover
Same	5-7	Pre-bloom thru 2nd Cover
Same 38-51 oz plus benomyl, dodine or SBI fungicides	5-7	Pre-bloom thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bitter rot	Glomerella cingulata	14.0	90.0
Black rot	Botryosphaeria obtusa	25.0	60.0
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Fly speck	Zygophiala jamicensis	65.0	90.0 fresh
Quince rust	Gymnosporangium clavipes	50.0	60.0
Scab	Venturia inaequalis	100.0	90.0
Sooty blotch	Gloeodes pomigena	70.0	90.0 fresh 5.0 processed

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

captan fungicide 24-64 oz ai/A (not effective against rust diseases)
metiram fungicide 38-102 oz ai/A
thiram 42-84 oz ai/A - likely to be 25% less effective than mancozeb
ziram 72-144 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to mancozeb known. Mancozeb fungicides used as companion fungicides with benomyl, fenarimol, myclobutanil, dodine, and thiophanate methyl

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 4,500 with 3-5 APPLICATIONS

4. FUNGICIDE maneb

a. Formulations:
Manex 37F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Manes 37F 60-112 oz	3-5	Pink thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Black rot	Botryosphaeria obtusa	25.0	60.0
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Scab	Venturia inaequalis	100.0	90.0

(1) Mathematical relationship between pest density and yield (if known):
Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:
captan fungicide 24-64 oz ai/A (not effective against rust diseases)
mancozeb fungicides 76-102 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known to apple pathogens, but is used in combination with unrelated fungicides such as benomyl, SBI, and thiophanate methyl.

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 18,500 with 2 APPLICATIONS

4. FUNGICIDE metalaxyl

a. Formulations: Ridomil 2E 25EC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Ridomil 2E 25EC 64-128 fl oz	2	early spring & late fall

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (dilute)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Phytophthora collar/ crown rot	Phytophthora cactorum	7.0	75.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size

f. Alternative fungicides, formulations, rates:

copper containing fungicides (Kocide 101 77WP 12 lb ai/A)

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known in apple pathogens but the probability exists unless metalaxyl is alternated with copper compounds.

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 13,960 with 9-10 APPLICATIONS

27,900 with 5-7 APPLICATIONS

4. FUNGICIDE metiram

a. Formulations:
Polyram 80WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Polyram 80WP 76-102 oz ai/A or Polyram 80WP, 38-51 oz ai/A plus benomyl, dodine, SBI	9-10	Green-tip thru 7th Cover
	5-7	Pre-bloom thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bitter rot	Glomerella cingulata	14.0	90.0
Black rot	Botryosphaeria obtusa	25.0	60.0
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Fly speck	Zygophiala jamicensis	65.0	90.0 fresh
Quince rust	Gymnosporangium clavipes	50.0	60.0
Scab	Venturia inaequalis	100.0	90.0
Sooty blotch	Gloeodes pomigena	70.0	90.0 fresh 5.0 processed

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

captan fungicide 24-64 oz ai/A (not effective against rust diseases)
mancozeb fungicides 38-102 oz ai/A
thiram 42-84 oz ai/A - likely to be 25% less effective than mancozeb
ziram 72-144 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to metiram known. Metiram fungicides used as companion fungicides with benomyl, fenarimol, myclobutanil, dodine, and thiophanate methyl

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 90,500 with 2-3 APPLICATIONS

78,200 with 6-8 APPLICATIONS

4. FUNGICIDE myclobutanil

a. Formulations: Nova 40WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Nova 40WP 1.5-4.0 oz or Nova 40WP 1.5-3.0 oz plus mancozeb fungicide	6-8	Green-tip thru 3rd Cover
	6-8	Green-tip thru 3rd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Black rot	Botryosphaeria obtusa	25.0	60.0
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Powdery mildew	Podosphaera leucotricha	40.0	65.0
Quince rust	Gymnosporangium clavipes	50.0	60.0
Scab	Venturia inaequalis	100.0	90.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size

f. Alternative fungicides, formulations, rates:

Rubigan 1E 0.75-1.5 oz ai/A (Not as effective against powdery mildew)

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known in apple pathogens, but the probability exists unless myclobutanil is used in combination with unrelated fungicide such as captan, mancozeb and dinocap.

b. Management practices using no chemical pesticides: Not likely to be able to grow apples without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 150,000 with 3-6 APPLICATIONS

4. FUNGICIDE streptomycin sulfate

a. Formulations: Agri-Strep Type D 21.2% WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Agri-Strep 21WP 5-10 oz	3-6	During bloom and immediate post-bloom period

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Fireblight	Erwinia amylovora	60.0	85.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Scab and deformed = 95% loss
Fruit blemishes = 60% loss
Cankers = Loss proportional to limbs lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal bactericidal sprays used when necessary along with pruning and adequate fertilization for tree growth and fruit size

f. Alternative fungicides, formulations, rates:

copper fungicides 48-128 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to streptomycin known to exist in several orchards in Missouri and may be present in others. Limiting applications to times most needed is the most effective method of avoiding tolerance development.

b. Management practices using no chemical pesticides:
Not likely to be able to grow some cultivars without fireblight control.

c. Diseases without adequate controls
Canker blight and terminal blight (fireblight)

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 9,500 with 3-4 APPLICATIONS

4. FUNGICIDE sulfur

a. Formulations:
Sulfur Spray APK 83WP; Thiolux 80DF; Super Six 52L

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Thiolux 80DF 8-14 lb	3-8	Tight-cluster thru 2nd Cover
or		
Sulfur Spray APK 83WP 15-20 lb	3-8	Tight-cluster thru 2nd Cover
or		
Super Six 52L 5-29 oz	3-8	Tight-cluster thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Powdery mildew	Podosphaera leucotricha	40.0	65.0
Scab	Venturia inaequalis	100.0	90.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:
Karathane WD 19.5WP 8-11 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known in apple pathogens.

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 1,200 with 10-11 APPLICATIONS

35,000 with 3-5 APPLICATIONS

4. FUNGICIDE thiophanate methyl

a. Formulations: Topsin M 70WP, Topsin M 4.5F 46F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Topsin M 70WP 11-45 oz	10-11	Green-tip thru 7th Cover
or		
Topsin M 70WP 8-12 oz plus captan fungicide 24-32 oz		
or		
mancozeb fungicide 38-51 oz	3-5	Green-tip thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bitter rot	Glomerella cingulata	14.0	90.0
Black rot	Botryosphaeria obtusa	25.0	60.0
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Fly speck	Zygophiala jamicensis	65.0	90.0 fresh
Powdery mildew	Podosphaera leucotricha	40.0	65.0
Quince rust	Gymnosporangium clavipes	50.0	60.0
Scab	Venturia inaequalis	100.0	90.0
Sooty blotch	Gloeodes pomigena	70.0	90.0 fresh 5.0 processed

1. Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Scab and deformed = 95% loss
Fruit blemishes = 60% loss
Cankers = Loss proportional to limbs lost, probably 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:
benomyl fungicide 3.0-6.0 ai/A plus
captan 18-32 oz ai/A or mancozeb 30-38 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES

a. Resistance management: Apple scab resistance common in many fruit growing regions. Thiophanate methyl must be used in combinations with captan, mancozeb, metiram, thiram, or ziram to avoid resistant development. Limit number of applications per year to 3-5.

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples without pesticides

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 500 with 10-11 APPLICATIONS

2,000 with 5-7 APPLICATIONS

4. FUNGICIDE thiram

a. Formulations:
Thiram 65WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Thiram 65WP 60-84 oz	10-11	Green-tip thru 7th Cover
Thiram 65WP 42-60 oz plus benomyl, dodine, SBI fungicides	5-7	Tight-cluster thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bitter rot	Glomerella cingulata	14.0	90.0
Black rot	Botryosphaeria obtusa	25.0	60.0
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Fly speck	Zygophiala jamicensis	65.0	90.0 fresh
Quince rust	Gymnosporangium clavipes	50.0	60.0
Scab	Venturia inaequalis	100.0	90.0
Sooty blotch	Gloeodes pomigena	70.0	90.0 fresh 5.0 processed

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

captan fungicide 24-64 oz ai/A (not effective against rust diseases)
mancozeb fungicides 38-102 oz ai/A
metiram fungicide 38-102 oz ai/A
ziram 72-144 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to thiram known. Thiram is used as a companion fungicide with benomyl, dodine, or SBI fungicides to avoid resistance development.

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 14,000 with 3-6 APPLICATIONS

4. FUNGICIDE triadimefon

a. Formulations:
Bayleton 50WP, Bayleton 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Bayleton 50WP 1.0-4.0 oz	3-6	Tight-cluster thru 3rd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Powdery mildew	Podosphera leucotricha	40.0	65.0
Quince rust	Gymnosporangium clavipes	50.0	60.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Karathane WD 19.5WP 8-11 oz ai/A (Does not control rust diseases)
Nova 40W 1.5-4.0 oz
Rubigan 12.5EC 0.75-1.5 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known in apple pathogens, but the probability exists unless triadimefon is used in combination with an unrelated fungicide such as dinocap.

b. Management practices using no chemical pesticides: Not likely to be able to grow apples commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED: 5,200 with 3-5 APPLICATIONS

4. FUNGICIDE triforine

a. Formulations:
Funginex 1.6EC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Funginex 18.2EC 6.5-7.3 oz	3-5	1/2" green thru Petal-fall

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Cedar-Apple rust	Gymnosporangium juniperi-virginianae	51.0	85.0
Powdery mildew	Podosphera leucotricha	40.0	65.0
Quince rust	Gymnosporangium clavipes	50.0	60.0
Scab	Venturia inaequalis	100.0	90.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Rubigan 1EC 0.75-1.5 oz ai/A
Nova 40W 0.5-1.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known in apple pathogens, but the probability exists unless triforine is used in combination or alternated with unrelated fungicides such as captan, mancozeb, and dinocap.

b. Management practices using no chemical pesticides: Not likely to be able to grow apples commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

FUNGICIDE BENEFITS REPORT

COMMODITY Apple (Malus domestica) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 279,110 2. ACRES HARVESTED: 279,000

3. ACRES TREATED:

Has not been recommended in the East until 1990

4. FUNGICIDE ziram

a. Formulations:
Ziram 76 WDG 76WP, Ziram F-4 40F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Ziram 76WDG 73-146 oz	5-7	Green-tip thru 7th Cover
Ziram 76WDG 60-173 oz plus benomyl, dodine, SBI fungicides	5-7	Tight-cluster thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Scab	Venturia inaequalis	100.0	90.0

(1) Mathematical relationship between pest density and yield (if known):

Fresh fruit - scab infected = 100% loss
Processed fruit - scab infected = 40% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:
captan fungicide 24-64 oz ai/A (not effective against rust diseases)
mancozeb fungicides 38-102 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to ziram known. Ziram is used alone or in companion with benomyl, dodine, thiophanate methyl, or SBI fungicides to avoid resistance development to these fungicides.

b. Management practices using no chemical pesticides:
Not likely to be able to grow apples commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

Fungicide Benefits on BLUEBERRY (Vaccinium corymbosum or V. ashei)

Blueberries grown commercially are primarily of two types; high bush (Vaccinium corymbosum) and rabbit's eye (V. ashei). Recorded acreage of these types grown in 14 states amount to 30,250 acres, 92% of which are grown in Michigan (18,000 acres), Massachusetts (2,000 acres), and New Jersey (7,800 acres) (Table 3). The southeastern states of North Carolina (3,600 acres) and Georgia (3,000 acres) grow 22% of the acreage. Less than 5% of the commercial blueberry acreage is grown in the western states of Washington (800 acres) and Oregon (600 acres). It is likely that several thousand additional acres are grown in small plantings that are not recorded but are produced as a commercial crop. The lowbush blueberry (V. angustifolium) commonly found growing wild along the Appalachian mountain chain from Alabama to Maine is managed for harvesting in some areas. An estimated 17,300 acres in Maine are managed for commercial consumption, but are generally not sprayed for pest control. The highbush and rabbit eye crops yield about 140 million pounds valued at approximately $100 million annually. The lowbush crop has been estimated at 80 million pounds bringing the estimated total value to $157 million.

Five or more fungal diseases that require fungicides for control occur widely and affect 30% to 90% of the commercial acreage. Yield losses due to leaf and twig blights, fruit rot, stem canker, and root rot ranges from 25% to 60% if not controlled. Disease losses are kept to commercially acceptable levels through the use of resistant cultivars, pruning, removal of diseased plant parts, and seasonally applied fungicide sprays. Protective fungicides benomyl, captan, or the combination of both are used on 50% to 75% of the acreage from budbreak through bloom. Triforine is also used on as much as 65% of the acreage during the same early season period under highly favorable environmental conditions for infection on leaves, stems, and fruit. Essentially all commercial plantings require 2 to 4 fungicide applications annually.

Table 3. Blueberry Bearing Acreage in the United States by Regions.

State/Region	Bearing Acres-1988	
	Highbush	Lowbush
Northeast		
Maine	50	17,300
Massachusetts	2,000	
New York	850	
Rhode Island	300	
Total	3,200	17,300
Northcentral		
Michigan	18,000	
Missouri	225	
Ohio	350	
Total	18,575	--
Southeast		
Georgia	3,000	
North Carolina	3,600	
South Carolina	400	
Tennessee	75	
Total	7,075	--
West		
Oregon	600	
Washington	800	
Total	1,400	
Total U. S.	30,250	17,300

FUNGICIDE BENEFITS REPORT

COMMODITY Blueberries SUB-COMMODITY Highbush (Vaccinium corymbosum)
Rabbits eye (V. ashei)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 28,850 2. ACRES HARVESTED: 28,850

3. ACRES TREATED: 14,400 with 2-3 APPLICATIONS

4. FUNGICIDE benomyl

a. Formulations: Benlate 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Benlate 50DF 8.0 oz	3-4	Green-tip thru bloom at 7-10 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers either high pressure or blower type (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Anthracnose (leaf and fruit)	(Gloeosporium minus)	30	25
Botrytis twigblight and berry rot	(Botrytis cinerea)	40	30
Fusicoccum canker	(Fusicoccum putrefaciens)	30	30
Phomopsis twigblight, stem canker, leafspot	(Phomopsis vaccinii)	90	60
Root rot	(Phytophthora cinnamomi)	80	25

(1) Mathematical relationship between pest density and yield (if known): Fruit decay - Loss is proportional to the percent fruit infected. Yield losses or reduction directly affected by foliar diseases causing leaf drop

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Diseases are

controlled by sprays applied seasonally, pruning, and removal of diseased parts is helpful in reducing disease incidence.

f. Alternative fungicides, formulations, rates:
Captan 50WP 2.5 lb ai/A; Funginex 18.2EC 4.4 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to benomyl likely unless the number of applications are limited to 2-3 per season. Use in combination with chemically unrelated fungicide like captan.

b. Management practices using no chemical pesticides: Resistant cultivars where available; sanitation in plantings consisting of removing diseased plants and plant parts; use of disease-free propagating wood.

c. Diseases without adequate controls

FUNGICIDE BENEFITS REPORT

COMMODITY Blueberries SUB-COMMODITY Highbush (Vaccinium corymbosum) Rabbits eye (V. ashei)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 28,850 2. ACRES HARVESTED: 28,850

3. ACRES TREATED: 21,600 with 3-4 APPLICATIONS

4. FUNGICIDE captan

a. Formulations: Captan 50WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Captan 50WP 2.5 lb	3-4	Green-tip thru bloom at 7-10 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers either high pressure or blower type (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Fusicoccum canker	(Fusicoccum putrefaciens)	30	30
Mummyberry	(Monilinia vaccinii-corymbosi)	20	20
Phomopsis twigblight, stem canker, leafspot	(Phomopsis vaccinii)	90	60

(1) Mathematical relationship between pest density and yield (if known): Fruit decay - Loss is proportional to the percent fruit infected. Yield losses or reduction directly affected by foliar diseases causing leaf drop

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Diseases are controlled by sprays applied seasonally, pruning, and removal of diseased parts is helpful in reducing disease incidence.

f. Alternative fungicides, formulations, rates:
Benlate 50WP 8.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to captan known.

b. Management practices using no chemical pesticides: Resistant cultivars where available; sanitation in plantings consisting of removing diseased plants and plant parts; use of disease-free propagating wood.

c. Diseases without adequate controls

FUNGICIDE BENEFITS REPORT

COMMODITY Blueberries SUB-COMMODITY Highbush (Vaccinium corymbosum) Rabbits eye (V. ashei)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 28,850 2. ACRES HARVESTED: 28,850

3. ACRES TREATED: 4,300 with 3-4 APPLICATIONS

4. FUNGICIDE sulfur

a. Formulations: Thiolux 80WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Thiolux 80WP 4.8-12 lb	3-4	Begin when shoots are 6" and repeat at 7-10 da intervals during and after bloom

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers either high pressure or blower type (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Root rot	(Phytophthora cinnamomi)	80	25

(1) Mathematical relationship between pest density and yield (if known): Fruit decay - Loss is proportional to the percent fruit infected. Yield losses or reduction directly affected by foliar diseases causing leaf drop

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Diseases are controlled by sprays applied seasonally, pruning, and removal of diseased parts is helpful in reducing disease incidence.

f. Alternative fungicides, formulations, rates:
Benlate 50WP 8.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to sulfur known.

b. Management practices using no chemical pesticides: Resistant cultivars where available; sanitation in plantings consisting of removing diseased plants and plant parts; use of disease-free propagating wood.

c. Diseases without adequate controls

FUNGICIDE BENEFITS REPORT

COMMODITY Blueberries SUB-COMMODITY Highbush (Vaccinium corymbosum) Rabbits eye (V. ashei)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 28,850 2. ACRES HARVESTED: 28,850

3. ACRES TREATED: 18,750 with 3-4 APPLICATIONS

4. FUNGICIDE triforine

a. Formulations: Funginex 1.6EC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Funginex 18.2EC 4.4 oz	3-4	Budbreak to bloom at 7-10 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers either high pressure or blower type (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Phomopsis twigblight, stem canker, leafspot	(Phomopsis vaccinii)	90	60

(1) Mathematical relationship between pest density and yield (if known): Fruit decay - Loss is proportional to the percent fruit infected. Yield losses or reduction directly affected by foliar diseases causing leaf drop

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Diseases are controlled by sprays applied seasonally, pruning, and removal of diseased parts is helpful in reducing disease incidence.

f. Alternative fungicides, formulations, rates:
Benlate 50WP 8.0 oz ai/A; Captan 50WP 2.5 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to triforine has not been reported but is potential if it is used in more than 2-3 applications

b. Management practices using no chemical pesticides: Resistant cultivars where available; sanitation in plantings consisting of removing diseased plants and plant parts; use of disease-free propagating wood.

c. Diseases without adequate controls

FUNGICIDE BENEFITS REPORT

COMMODITY Blueberries SUB-COMMODITY Highbush (Vaccinium corymbosum) Rabbits eye (V. ashei)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 28,850 2. ACRES HARVESTED: 28,850

3. ACRES TREATED: 2,000 with 2-3 APPLICATIONS

4. FUNGICIDE ziram

a. Formulations: Ziram F-4 41.5%

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Ziram F-4 66 oz ai/A	2-3	Blossoming period

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers either high pressure or blower type (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Fusicoccum canker	(Fusicoccum putrefaciens)	30	30
Phomopsis twigblight, stem canker, leafspot	(Phomopsis vaccinii)	90	60

(1) Mathematical relationship between pest density and yield (if known): Fruit decay - Loss is proportional to the percent fruit infected. Yield losses or reduction directly affected by foliar diseases causing leaf drop

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Diseases are controlled by sprays applied seasonally, pruning, and removal of diseased parts is helpful in reducing disease incidence.

f. Alternative fungicides, formulations, rates:
Captan 50WP 2.5 lb ai/A; Funginex 1.6EC 4.4 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to ziram known.

b. Management practices using no chemical pesticides: Resistant cultivars where available; sanitation in plantings consisting of removing diseased plants and plant parts; use of disease-free propagating wood.

c. Diseases without adequate controls

Fungicide Benefits on CANEBERRIES

Red Raspberry (Rubus ideaus strigosus)
Black Raspberry (Rubus occidentalis)
Loganberry (Boysenberry) (Rubus loganobaccus)
Dewberry (Rubus flagellaris)
Blackberry (Rubus allegheniensis)

Caneberries are grown throughout the United States in relatively small plantings many of which are not reported as commercial acreage. Estimates of acreages produce for commercial sales ranges from 10,000 to 20,000 acres. Most states report less than 1,000 acres with about equal acreage in the northeast (6 states), northcentral (4 states), and western regions. Raspberries are grown most commonly as a commercial crop (11,500 acres) while blackberries are grown commercially (7,650 acres) and also harvested from many wild plantings along fence rows and in uncultivated fields. The estimated crop of 96 million pounds is valued between $72 - $120 million.

Five to seven fungal diseases are commonly found on caneberry crops grown in humid regions. Anthracnose and fruit rot occurs on 60% to 70% of the acreage with losses of up to 100% where not controlled. Leaf and cane spot, spur blight, and powdery mildew occur on susceptible types or cultivars and may cause damage ranging from 15% to 80%. Fungicidal sprays are generally required for acceptable control. No registered fungicide is effective against orange rust and knowledge of efficacy of the relatively new fungicides is limited. The selection and planting of resistant cultivars, annual pruning, removal of diseased parts, and trellising are helpful in preventing excessive loss due to fungal diseases.

FUNGICIDE BENEFITS REPORT

COMMODITY Caneberries SUB-COMMODITY Blackberry (Rubus allegheniensis)
Dewberry (Rubus flagellaris)
Loganberry (Boysenberry) Rubus loganobaccus)
Raspberry (Rubus ideaus strigosus) - red
(Rubus occidentalis) - black

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5955 2. ACRES HARVESTED: 5955

3. ACRES TREATED: 4760 with 3-5 APPLICATIONS

4. FUNGICIDE benomyl

a. Formulations: Benlate 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Benlate 50DF 6.0 oz	5	bloom and post-bloom period at 14 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): High pressure or blower ground sprayer (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Fruit rot	(Botrytis cinerea)	100	60
Powdery mildew	(Sphaerotheca macularis)	50	20

(1) Mathematical relationship between pest density and yield (if known):

Loss from fruit decay is proportional to percent infection. Leafspots and cane infections caused reduced yields and plant loss related to level of disease severity.

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Caneberries must be sprayed with fungicides to protect canes, leaves, and fruit. Annual pruning to improve air circulation and removal of diseased parts aid in control.

f. Alternative fungicides, formulations, rates:
Captec 4L 32-48 oz ai/A (Does not control P. mildew).

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Benomyl should be used in combination with chemically unrelated fungicides or limited to 2-3 applications per season.

b. Management practices using no chemical pesticides: Removal of diseased canes, weed control, and trellising to keep canes of the ground all help to control diseases.

c. Diseases without adequate controls
orange rust, root rots

FUNGICIDE BENEFITS REPORT

COMMODITY Caneberries SUB-COMMODITY Blackberry (Rubus allegheniensis)
Dewberry (Rubus flagellaris)
Loganberry (Boysenberry) Rubus loganobaccus)
Raspberry (Rubus ideaus strigosus) - red
(Rubus occidentalis) - black

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5955 2. ACRES HARVESTED: 5955

3. ACRES TREATED: 4760 with 3-6 APPLICATIONS

4. FUNGICIDE captan

a. Formulations: Captec 4L

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Captec 4L 32-48 oz	2-5	2 appl. near blossoming 3-5 appl. during harvest

c. Methods of application (% aerial coverage vs blower, irrigation, etc): High pressure or blower ground sprayer (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Anthracnose	(Elsinoe veneta)	60	15-80
Fruit rot	(Botrytis cinerea)	100	60
Spur blight	(Didymella applanata)	60	10-50

(1) Mathematical relationship between pest density and yield (if known):

Loss from fruit decay is proportional to percent infection. Leafspots and cane infections caused reduced yields and plant loss related to level of disease severity.

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Caneberries must be sprayed with fungicides to protect canes, leaves, and fruit. Annual pruning to improve air circulation and removal of diseased parts aid in control.

f. Alternative fungicides, formulations, rates:
Benlate 50DF 6.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to captan reported.

b. Management practices using no chemical pesticides: Removal of diseased canes, weed control, and trellising to keep canes of the ground all help to control diseases.

c. Diseases without adequate controls
orange rust, Powdery mildew

FUNGICIDE BENEFITS REPORT

COMMODITY Caneberries SUB-COMMODITY Blackberry (Rubus allegheniensis)
Dewberry (Rubus flagellaris),
Loganberry (Boysenberry) (Rubus loganobaccus)
Raspberry (Rubus ideaus strigosus) - red
(Rubus occidentalis) - black

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5955 2. ACRES HARVESTED: 5955

3. ACRES TREATED: 3575 with 1 APPLICATIONS

4. FUNGICIDE calcium polysulphide

a. Formulations: Liquid Lime Sulfur 29% Sol.

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Liquid Lime Sulfur 29L 50-60 lb	1	Budbreak

c. Methods of application (% aerial coverage vs blower, irrigation, etc): High pressure or blower ground sprayer (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Anthracnose	(Elsinoe veneta)	60	15-80
Leaf and cane spot	(Septoria rubi)	30	25
Spur blight	(Didymella applanata)	60	10-50

(1) Mathematical relationship between pest density and yield (if known):

Loss proportional to loss of canes and yield reduction due to cane and leaf infections (10-25% when uncontrolled).

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Caneberries must be sprayed with fungicides to protect canes, leaves, and fruit. Annual pruning to improve air circulation and removal of diseased parts aid in control.

f. Alternative fungicides, formulations, rates:
Kocide 101 77 WP 50 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to calcium polysulphide known.

b. Management practices using no chemical pesticides: Removal of diseased canes, weed control, and trellising to keep canes of the ground all help to control diseases.

c. Diseases without adequate controls
orange rust, Powdery mildew

FUNGICIDE BENEFITS REPORT

COMMODITY Caneberries SUB-COMMODITY Blackberry (Rubus allegheniensis)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5955 2. ACRES HARVESTED: 5955

3. ACRES TREATED: 250 with 1-2 APPLICATIONS

4. FUNGICIDE copper hydroxide

a. Formulations: Kocide 101 77WP; Kocide 606 37.5F

b. Federal/State recommendations or guidelines:

Fungicide, Form, Rate (ai/A)	No. of Applications	Timing range or avg.
Kocide 101 77WP 50 oz	1-2	Spring and/or Fall

c. Methods of application (% aerial coverage vs blower, irrigation, etc): High pressure or blower ground sprayer (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Leaf and cane spot	(Septoria rubi)	30	25

(1) Mathematical relationship between pest density and yield (if known):

Loss proportional to loss of canes and yield reduction due to cane and leaf infections (10-25% when uncontrolled).

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Caneberries must be sprayed with fungicides to protect canes, leaves, and fruit. Annual pruning to improve air circulation and removal of diseased parts aid in control.

f. Alternative fungicides, formulations, rates:
Calcium polysulfide 29L 50-60 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to copper known

b. Management practices using no chemical pesticides: Removal of diseased canes, weed control, and trellising to keep canes of the ground all help to control diseases.

c. Diseases without adequate controls
orange rust, Powdery mildew

FUNGICIDE BENEFITS REPORT

COMMODITY Caneberries SUB-COMMODITY Blackberry (Rubus allegheniensis)
Dewberry (Rubus flagellaris)
Loganberry (Boysenberry) Rubus loganobaccus)
Raspberry (Rubus ideaus strigosus) - red
(Rubus occidentalis) - black

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5955 2. ACRES HARVESTED: 5955

3. ACRES TREATED: 300 with 1-2 APPLICATIONS

4. FUNGICIDE copper sulfate

a. Formulations: Basicop 53WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Basicop 53WP 51 oz	2	bud-break, early bloom
Basicop 53WP 9.5 lb	2	bud-swell & bloom (orange rust)

c. Methods of application (% aerial coverage vs blower, irrigation, etc): High pressure or blower ground sprayer (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Anthracnose	(Elsinoe veneta)	60	15-80
Leaf and cane spot	(Septoria rubi)	30	25
Orange rust	(Gymnoconia peckiana or Kunkelia nitens)	45	90

(1) Mathematical relationship between pest density and yield (if known):

Loss proportional to loss of canes and yield reduction due to cane infection.

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Caneberries must be sprayed with fungicides to protect canes, leaves, and fruit. Annual pruning to improve air circulation and removal of diseased parts aid in control.

f. Alternative fungicides, formulations, rates:
Calcium polysulfide 29L 50-60 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to copper known

b. Management practices using no chemical pesticides: Removal of diseased canes, weed control, and trellising to keep canes of the ground all help to control diseases.

c. Diseases without adequate controls
orange rust, Powdery mildew

FUNGICIDE BENEFITS REPORT

COMMODITY Caneberries SUB-COMMODITY
Raspberry (Rubus ideaus strigosus) - red
(Rubus occidentalis) - black

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5955 2. ACRES HARVESTED: 5955

3. ACRES TREATED: 2390 with 2 APPLICATIONS

4. FUNGICIDE metalaxyl

a. Formulations: Ridomil 2E 25%

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Ridomil 2E 58.0 oz ai	2	Spring and Fall

c. Methods of application (% aerial coverage vs blower, irrigation, etc): High pressure or blower ground sprayer (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Root rot	(Phythophthora megasperma or P. cryptogea or P. citricola or P. cactorum)	30	50-100

(1) Mathematical relationship between pest density and yield (if known):

Loss is proportional to percent of canes lost to disease.

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Caneberries must be sprayed with fungicides to protect canes, leaves, and fruit. Annual pruning to improve air circulation and removal of diseased parts aid in control.

f. Alternative fungicides, formulations, rates:
None

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to metalaxyl is probable unless usage is limited

b. Management practices using no chemical pesticides: Removal of diseased canes, weed control, and trellising to keep canes of the ground all help to control diseases.

c. Diseases without adequate controls
orange rust, Powdery mildew

FUNGICIDE BENEFITS REPORT

COMMODITY Caneberries SUB-COMMODITY Blackberry (Rubus allegheniensis)
Dewberry (Rubus flagellaris)
Loganberry (Boysenberry) Rubus loganobaccus)
Raspberry (Rubus ideaus strigosus) - red
(Rubus occidentalis) - black

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5955 2. ACRES HARVESTED: 5955

3. ACRES TREATED: 2390 with 2-3 APPLICATIONS

4. FUNGICIDE vinclozolin

a. Formulations: Ronilan 50WP

b. Federal/State recommendations or guidelines:

Fungicide, Form, Rate (ai/A)	No. of Applications	Timing range or avg.
Ronilan 4-8 oz	3-4	Bloom and Post-bloom period at 14 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): High pressure or blower ground sprayer (95%) vs aerial (5%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Fruit rot	Botrytis cinerea)	100	60

(1) Mathematical relationship between pest density and yield (if known):

Loss from fruit decay is proportional to percent infected.

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Caneberries must be sprayed with fungicides to protect canes, leaves, and fruit. Annual pruning to improve air circulation and removal of diseased parts aid in control.

f. Alternative fungicides, formulations, rates:
Captec 4L 32-48 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to vinclozolin is probable unless applications are limited to 2-3 per year or used in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Removal of diseased canes, weed control, and trellising to keep canes of the ground all help to control diseases.

c. Diseases without adequate controls
orange rust, Powdery mildew

Fungicide Benefits on CHERRY
Tart (Prunus syringae)
Sweet (Prunus avium)

The commercial production of tart and sweet cherries in the United States is 304,300 metric tons annually valued at $200 million. Although the acreage of each are similar nationally (tart, 47,810 acres; sweet, 47,100 acres), the major acreage of tarts is in Michigan, New York, Utah, Oregon, and Pennsylvania, while the major sweet cherry production is in Washington, Oregon, California, and Michigan (Table 4). The sweet cherry crop is valued at $145.4 million and tarts have an annual value of $53.9 million.

Both tart and sweet cherries are susceptible to five or more fungal pathogens that require fungicide sprays for control. Sweet cherries or more susceptible to brown rot on blossoms and fruit. Brown rot occurs on 75% to 100% of the acreage and causes from 60% to 100% loss if not treated with fungicides. Cherry leaf spot affects both sweet and tart cherries, but losses are greater on tarts. This fungus disease occurs in essentially all orchards and may cause 80% to 100% yield loss due to defoliation. The prevention of premature defoliation is very important because it can lead to low temperature injury which can cause death of trees in the colder climates of the northcentral and northeastern regions. Effective fungicides must be applied to prevent tree losses.

Strains of the fungi causing brown rot and leaf spot that are resistant to dodine and benzimidazole fungicides have developed in orchards extensively sprayed with these fungicides. Other effective fungicides such as captan, chlorothalonil, triforine, iprodione, and vinclozolin must be used in these orchards at significantly higher rates and costs. Strains of the brown rot pathogen resistant to iprodione and vinclozolin have also been reported in some commercial orchards. Captan and chlorothalonil are companion fungicides that are used in combination to delay the development of resistance.

Table 4. Cherries Bearing Acres and Production in the United States by Regions

State/Region	Bearing Acres-1988 Tart	Bearing Acres-1988 Sweet	Production Tons Tart	Production Tons Sweet
Northeast				
New York	5,200	700	11,000	1,400
Total	5,200	700	11,000	1,400
Northcentral				
Michigan	33,300	9,400	90,000	28,000
Wisconsin	2,810	--	4,450	--
Total	36,110	9,400	94,450	28,000
Mid-Atlantic				
Pennsylvania	1,600	300	4,500	1,200
Total	1,600	300	4,500	1,200
West				
California		10,300		26,000
Colorado	400	--	650	--
Idaho	--	600	--	2,300
Montana	--	900	--	3,300
Oregon	1,800	11,300	2,000	60,000
Utah	2,700	800	5,500	2,000
Washington	--	12,800	--	62,000
Total	4,900	36,700	8,150	155,600
Total U.S.	47,810	47,100	118,100	186,200

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 5,200 with 1-3 APPLICATIONS (Sweet)

4,300 with 1-2 APPLICATIONS (Tart)

4. FUNGICIDE benomyl

a. Formulations:
Benlate 50WP, 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Benlate 50DF 8.0-16.0 oz plus Captan 50WP 24-32 oz	1-3	1-2	Pre-bloom, bloom & harvest or
Other chemically unrelated fungicides	1-3	1-2	Pre-bloom, bloom & harvest

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Brown rot blossom blight	Monilinia fructicola or M. laxa	75.0	20.0	60.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	100.0	100.0	75.0
Cherry leaf spot	Coccomyces hiemalis	100.0	100.0	80.0	100.0
Powdery mildew	Podosphaera oxyacanthae	5.0	50.0	2.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Topsin-M 70WP 8-16 oz ai/Aplus
Captan 50WP 24-32 oz ai/A
Rovral 50WP 0.5-1.0 lb ai/A
Ronilan 50WP 0.5-1.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to benomyl exists in several regions. The use of combinations with chemically unrelated fungicides is recommended. The use of unrelated fungicides at different "block times" during season is also beneficial in avoiding resistance development.

b. Management practices using no chemical pesticides:
Not likely to be able to grow cherries commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 5,200 with 1-3 APPLICATIONS (Sweet)

4,300 with 2 APPLICATIONS (Tart)

4. FUNGICIDE captan

a. Formulations:
Captan 50WP or 80WP; Captec 4F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Captan 50WP 2.0 lb	1-3	1-2	Pre-bloom, bloom & harvest
Captan 50WP 1.0-1.5 lb plus sulfur, benomyl, triforine, iprodione, vinclozolin	1-3	1-2	Pre-bloom, bloom & harvest

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Brown rot blossom blight	Monilinia fructicola or M. laxa	75.0	20.0	60.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	100.0	100.0	75.0
Botrytis rot	Botrytis cinerea	10.0	5.0	20.0	10.0
Cherry leaf spot	Coccomyces hiemalis	100.0	100.0	80.0	100.0
Powdery mildew	Podosphaera oxyacanthae	5.0	50.0	2.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Rovral 50WP 0.5-1.0 lb ai/A
Ronilan 50WP 0.5-1.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to captan known. Captan used as a companion fungicide with benomyl, triforine, iprodione, vinclozolin.

b. Management practices using no chemical pesticides:
Annual pruning to allow for rapid drying. Cherries probably cannot be grown without fungicide usage for brown rot and leaf spot control.

c. Diseases without adequate controls
Cytospora canker, bacterial canker

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 2,600 with 2-3 APPLICATIONS (Sweet)

34,300 with 2-3 APPLICATIONS (Tart)

4. FUNGICIDE chlorothalonil

a. Formulations:
Bravo 720 54LC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Bravo 720 54LC 27-36 oz	2-3		Pre-bloom, bloom, petal-fall

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Brown rot blossom blight	Monilinia fructicola or M. laxa	75.0	20.0	60.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Leaf spot = Yield reduction to loss of trees depending on proportion of defoliation
Cankers = Proportioned to branches lost

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is

necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Captan 50WP 2.0 lb ai/A
Rovral 50WP 0.5-1.0 lb ai/A
Ronilan 50WP 0.5-1.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to chlorothalonil known. Can be used during blossoming period to assist in preventing resistant development in pathogens to other fungicides such as benomyl, iprodione, triforine, and vinclozolin

b. Management practices using no chemical pesticides:
Annual pruning to allow for rapid drying. Cherries probably cannot be grown without fungicide usage for brown rot and leaf spot control.

c. Diseases without adequate controls
Cytospora canker, bacterial canker

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 5,200 with 1-2 APPLICATIONS (Sweet)

2,200 with 1 APPLICATIONS (Tart)

4. FUNGICIDE copper

a. Formulations:
Kocide 101 77WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Kocide 101 77WP 74-148 oz		1	Dormant
Kocide 101 77WP 50-110 oz		1-2	Pre-bloom, bloom

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Bacterial Canker	Pseudomonas syringae	50.0	5.0	10.0	5.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Leaf spot = Yield reduction to loss of trees depending on proportion of defoliation
Cankers = Proportioned to branches lost

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide treatment is necessary along with annual pruning, fertilizing, weed control, and irrigation as needed for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

None

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to copper fungicides known.

b. Management practices using no chemical pesticides:
Annual pruning to allow for rapid drying. Cherries probably cannot be grown without fungicide usage for brown rot and leaf spot control.

c. Diseases without adequate controls
Cytospora canker, bacterial canker

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 800 with 3-4 APPLICATIONS (Sweet)

Fruit from 5,000 with 1 APPLICATIONS (Tart)
(Post-harvest dip)

4. FUNGICIDE dicloran

a. Formulations:
Botran 75WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Botran 75WP 12-16 oz	3-4		Bloom, harvest time
Botran 75WP 32 oz plus Captan 50WP 16 oz	1		Post-harvest dip

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Brown rot blossom blight	Monilinia fructicola or M. laxa	75.0	20.0	60.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	100.0	100.0	75.0
Rhizopus rot	Rhizopus nigricans	80.0	40.0	90.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Leaf spot = Yield reduction to loss of trees depending on proportion of defoliation
Cankers = Proportioned to branches lost

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide treatment is necessary along with annual pruning, fertilizing, weed control, and irrigation as needed for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Captan 50WP 2.0 lb ai/A (brown rot)
Captan 50WP 1.0 lb ai/100 gal (post-harvest dip)

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known to dicloran.

b. Management practices using no chemical pesticides:
Annual pruning to allow for rapid drying. Cherries probably cannot be grown without fungicide usage for brown rot and leaf spot control.

c. Diseases without adequate controls
Cytospora canker, bacterial canker

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 6,700 with 3-4 APPLICATIONS (Sweet)

4,300 with 2 APPLICATIONS (Tart)

4. FUNGICIDE ferbam

a. Formulations:
Carbamate WDG 76WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Carbamate WDG 76WP 18 oz	3-4		Petal-fall thru 4th Cover
or Carbamate WDG 76WP 12 oz plus Wettable sulfur 95WP 45 oz	2-4		Petal-fall thru 4th Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Brown rot blossom blight	Monilinia fructicola or M. laxa	75.0	20.0	60.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	100.0	100.0	75.0
Cherry leaf spot	Coccomyces hiemalis	100.0	100.0	80.0	100.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Leaf spot = Yield reduction to loss of trees depending on proportion of defoliation
Cankers = Proportioned to branches lost

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide treatment is necessary along with annual pruning, fertilizing, weed control, and irrigation as needed for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Captan 50WP 2.0 lb ai/A
Rovral 50WP 0.5-1.0 lb ai/A
Ronilan 50WP 0.5-1.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to ferbam known. Ferbam could be used with other fungicides such as benomyl, triforine, iprodione, vinclozolin to avoid resistance development to these compounds.

b. Management practices using no chemical pesticides:
Annual pruning to allow for rapid drying. Cherries probably cannot be grown without fungicide usage for brown rot and leaf spot control.

c. Diseases without adequate controls
Cytospora canker, bacterial canker

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 6,760 with 3 APPLICATIONS (Sweet)

4,300 with 2 APPLICATIONS (Tart)

4. FUNGICIDE iprodione

a. Formulations:
Rovral 50WP, 4F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Rovral 50WP 8-16 oz	2-3		Bloom, harvest time

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Brown rot blossom blight	Monilinia fructicola or M. laxa	75.0	20.0	60.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	100.0	100.0	75.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Leaf spot = Yield reduction to loss of trees depending on proportion of defoliation
Cankers = Proportioned to branches lost

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide treatment is necessary along with annual pruning, fertilizing, weed control, and irrigation as needed for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Captan 50WP 2.0 lb ai/A
Ronilan 50WP 0.5-1.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance known to iprodione in some areas and in several pathogens. Companion chemically non-related fungicides should be used with iprodione or be used during part of the growing season.

b. Management practices using no chemical pesticides:
Annual pruning to allow for rapid drying. Cherries probably cannot be grown without fungicide usage for brown rot and leaf spot control.

c. Diseases without adequate controls
Cytospora canker, bacterial canker

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 6,800 with 3-4 APPLICATIONS (Sweet)

27,900 with 3-4 APPLICATIONS (Tart)

4. FUNGICIDE sulfur

a. Formulations:
Thiolux 80DF
Super Six 52L

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Thiolux 80DF 8-24 lb	3-4		Bloom, harvest period
or			
Super Six 52L 5-29 oz	3-4		Bloom, harvest period
Sulfur 80DF 8-16 lb	3-4		Bloom, harvest period

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Brown rot blossom blight	Monilinia fructicola or M. laxa	75.0	20.0	60.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	100.0	100.0	75.0
Cherry leaf spot	Coccomyces hiemalis	100.0	100.0	80.0	100.0
Powdery mildew	Podosphaera oxyacanthae	5.0	50.0	2.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Leaf spot = Yield reduction to loss of trees depending on proportion of defoliation
Cankers = Proportioned to branches lost

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide treatment is necessary along with annual pruning, fertilizing, weed control, and irrigation as needed for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Benlate 50WP 8-16 oz ai/A
Captan 50WP 2.0 lb ai/A (Does not control Powdery mildew)

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to sulfur known.

b. Management practices using no chemical pesticides:
Annual pruning to allow for rapid drying. Cherries probably cannot be grown without fungicide usage for brown rot and leaf spot control.

c. Diseases without adequate controls
Cytospora canker, bacterial canker

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 520 with 1-3 APPLICATIONS (Sweet)

4,300 with 1-2 APPLICATIONS (Tart)

4. FUNGICIDE thiophanate methyl

a. Formulations:
Topsin-M 70WP, 4.5F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Topsin-M 70WP 8.0-16.0 oz plus Captan 50WP 24-32 oz	1-2	1	Pre-bloom, bloom

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Brown rot blossom blight	Monilinia fructicola or M. laxa	75.0	20.0	60.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	100.0	100.0	75.0
Cherry leaf spot	Coccomyces hiemalis	100.0	100.0	80.0	100.0
Powdery mildew	Podosphaera oxyacanthae	5.0	50.0	2.0	10.0

1. Mathematical relationship between pest density and yield (if known)

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Benlate 50WP 8-16 oz ai/Aplus
Captan 50WP 24-32 oz ai/A
Rovral 50WP 0.5-1.0 lb ai/A
Ronilan 50WP 0.5-1.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to thiophanate methyl exists in several regions. The use of combinations with chemically unrelated fungicides is recommended. The use of unrelated fungicides at different "block times" during season is also beneficial in avoiding resistance development.

b. Management practices using no chemical pesticides:
Not likely to be able to grow cherries commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, nectria, black pox.

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 200 with 1 APPLICATIONS (Sweet)

4,200 with 1 APPLICATIONS (Tart)

4. FUNGICIDE triforine

a. Formulations:
Funginex 1.6EC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Funginex 1.6EC 6.5-8.7 oz		2-3	Bloom, harvest time

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Brown rot blossom blight	Monilinia fructicola or M. laxa	75.0	20.0	60.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Leaf spot = Yield reduction to loss of trees depending on proportion of defoliation
Cankers = Proportioned to branches lost

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide treatment is necessary along with annual pruning, fertilizing, weed control, and irrigation as needed for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Captan 50WP 2.0 lb ai/A
Rovral 50WP 0.5-1.0 lb ai/A
Ronilan 50WP 0.5-1.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to triforine known.

b. Management practices using no chemical pesticides:
Annual pruning to allow for rapid drying. Cherries probably cannot be grown without fungicide usage for brown rot and leaf spot control.

c. Diseases without adequate controls
Cytospora canker, bacterial canker

FUNGICIDE BENEFITS REPORT

COMMODITY Cherry SUB-COMMODITY Tart (Prunus syringae)
Sweet (Prunus avium)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 53,310 2. ACRES HARVESTED: 53,310

3. ACRES TREATED: 1,050 with 3 APPLICATIONS (Sweet)

8,600 with 2 APPLICATIONS (Tart)

4. FUNGICIDE vinclozolin

a. Formulations:
Ronilan 50WP, 41% FL

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications		Timing range or avg.
	Sweet	Tart	
Ronilan 50WP 8-16 oz	2-3		Bloom, harvest time

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected		% Yield Loss Without Control	
		Sweet	Tart	Sweet	Tart
Brown rot blossom blight	Monilinia fructicola or M. laxa	75.0	20.0	60.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	100.0	100.0	75.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Leaf spot = Yield reduction to loss of trees depending on proportion of defoliation
Cankers = Proportioned to branches lost

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide treatment is necessary along with annual pruning, fertilizing, weed control, and irrigation as needed for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Captan 50WP 2.0 lb ai/A
Rovral 50WP 0.5-1.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to vinclozolin known in some areas. Other chemically unrelated fungicides should be used during part of the growing season or be used as companion fungicides in tank mixes.

b. Management practices using no chemical pesticides:
Annual pruning to allow for rapid drying. Cherries probably cannot be grown without fungicide usage for brown rot and leaf spot control.

c. Diseases without adequate controls
Cytospora canker, bacterial canker

Fungicide Benefits on CRANBERRY (*Vaccinium macrocarpum*)

The production of cranberries is a highly specialized enterprise limited mainly to Massachusetts, New Jersey, and Wisconsin in the eastern United States and to Washington and Oregon in the west. The total U. S. production of 4.0 million barrels, valued at $178.9 million is produced on 25,900 acres. Massachusetts leads in production with 11,800 acres (46% of total) producing 1.9 million barrels and valued at $84.8 million. Wisconsin is second in production with 8,300 acres (32% of total) valued at $64.5 million (Table 5).

Cranberry producers must control at least eight fungal pathogens which cause significant disease loss. Early rot (*Phyllosticta vaccinii*) occurs in all commercial bogs and can cause 100% loss if not controlled. Other diseases that occur commonly can produce losses ranging from 25% to 50%. Disease control is attained through the use of 2-3 fungicide applications timed during the bloom and immediate post-bloom periods. Fungicide sprays are used in conjunction with other control measures including the sanding of bogs and the use of resistant cultivars when possible.

Chlorothalonil is the fungicide most extensively used (75% of acreage) because of its high efficacy against several diseases. Mancozeb was also commonly used (40% of acreage) before registration was withdrawn. Ferbam usage is about the same level as mancozeb, while copper is used on 25% of the acreage. Pathogen populations resistant to the fungicides used have not been detected, most probably because of the limited number of applications per year.

Table 5. Cranberries Bearing Acres and Production in the United States by Regions

State/Region	Bearing Acres-1988	Production Barrels
Northeast		
Massachusetts	11,800	1,910,000
Total	11,800	1,910,000
Northcentral		
Wisconsin	8,300	1,450,000
Total	8,300	1,450,000
Mid-Atlantic		
New Jersey	3,300	370,000
Total	3,300	370,000
West		
Oregon	1,300	154,000
Washington	1,200	135,000
Total	2,500	289,000
Total U.S.	25,900	4,019,000

FUNGICIDE BENEFITS REPORT

COMMODITY Cranberry (Vaccinium macrocarpum) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 23,400 2. ACRES HARVESTED: 23,400

3. ACRES TREATED: 17,550 with 3 APPLICATIONS

4. FUNGICIDE chlorothalonil

a. Formulations: Bravo 500L 40.4%; Bravo 720L 54.0%

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Bravo 720 54L 39-65 oz	2-3	bloom and 14 and 28 days later

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer or sprinkler (90%), aerial (10%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Berry rot/leaf spot	Phyllosticta elongata	5.0	25.0
Bitter rot	Glomerella cingulata	10.0	10.0
Blotch rot/leaf spot	Physalospora vaccinii	25.0	25.0
Early rot	Phyllosticta vaccinii	100.0	100.0
End rot	Godronia cassandrae var vaccinii	50.0	50.0
Fairy ring	Psilocybe agrariella var vaccinii	10.0	30.0
Penicillium rot	Penicillium expansum	5.0	15.0
Twig blight/Leafspot	Phomopsis vaccinii	25.0	50.0

(1) Mathematical relationship between pest density and yield (if known):

Loss is proportional to percent fruit decay at low to moderate levels but may be 100% if decay is above acceptable level.

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicide sprays are used as needed along with late flooding of bogs, sanding bogs with one inch of sand, and the use of resistant cultivars

f. Alternative fungicides, formulations, rates:
Carbamate WDG 76WP 4.6 lb ai/A
Kocide 101 77WP 6.2 lb ai/A
Dithane M-45 80WP 38 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance has developed to chlorothalonil.

b. Management practices using no chemical pesticides:
Late flooding and sanding of bogs

c. Diseases without adequate controls:
Upright dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Cranberry (Vaccinium macrocarpum) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 23,400 2. ACRES HARVESTED: 23,400

3. ACRES TREATED: 5,850 with 1-2 APPLICATIONS

4. FUNGICIDE copper

a. Formulations: Kocide 101 77W; Kocide 606 37.5F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Kocide 101 77W 6.2 lb	1-3	bloom and 12 and 24 days later

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer or sprinkler (90%), aerial (10%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Berry rot/leaf spot	Phyllosticta elongata	5.0	25.0
Bitter rot	Glomerella cingulata	10.0	10.0
Blotch rot/leaf spot	Physalospora vaccinii	25.0	25.0
Early rot	Phyllosticta vaccinii	100.0	100.0
Fairy ring	Psilocybe agrariella var vaccinii	10.0	30.0

(1) Mathematical relationship between pest density and yield (if known):

Loss is proportional to percent fruit decay at low to moderate levels but may be 100% if decay is above acceptable level.

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicide sprays are used as needed along with late flooding of bogs, sanding bogs with one inch of sand, and the use of resistant cultivars.

f. Alternative fungicides, formulations, rates:
Carbamate WDG 76WP 4.6 lb ai/A
Bravo 720 54L 39-65 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance has developed to copper.

b. Management practices using no chemical pesticides:
Late flooding and sanding of bogs

c. Diseases without adequate controls:
Upright dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Cranberry (Vaccinium macrocarpum) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 23,400 2. ACRES HARVESTED: 23,400

3. ACRES TREATED: 9,360 with 2 APPLICATIONS

4. FUNGICIDE ferbam

a. Formulations: Carbamate WDG 76WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Carbamate WDG 76WP 4.6 lb	4-5	bloom and at 14 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer or sprinkler (90%), aerial (10%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Berry rot/leaf spot	Phyllosticta elongata	5.0	25.0
Bitter rot	Glomerella cingulata	10.0	10.0
Blotch rot/leaf spot	Physalospora vaccinii	25.0	25.0
Early rot	Phyllosticta vaccinii	100.0	100.0
End rot	Godronia cassandrae var vaccinii	50.0	50.0
Fairy ring	Psilocybe agrariella var vaccinii	10.0	30.0
Penicillium rot	Penicillium expansum	5.0	15.0
Twig blight	Sporomega degenerans	25.0	50.0

(1) Mathematical relationship between pest density and yield (if known):

Loss is proportional to percent fruit decay at low to moderate levels but may be 100% if decay is above acceptable level

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicide sprays are used as needed along with late flooding of bogs, sanding bogs with one inch of sand, and the use of resistant cultivars.

f. Alternative fungicides, formulations, rates:
Kocide 101 77W 6.2 lb ai/A (Not as effective against twig blight)
Bravo 720 54L 39-65 oz ai/A
Dithane M-45 80WP 38 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance has developed to ferbam.

b. Management practices using no chemical pesticides:
Late flooding and sanding of bogs

c. Diseases without adequate controls:
Upright dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Cranberry (Vaccinium macrocarpa) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 23,400 2. ACRES HARVESTED: 23,400

3. ACRES TREATED: 9,360 with 2 APPLICATIONS

4. FUNGICIDE mancozeb

a. Formulations:
Dithane M-45 80WP; Dithane F-45 37F; Dithane 75DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Dithane M-45 80WP 38 oz	2-3	Bloom, 1-2 applic. at 7-10 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer or sprinkler (90%), aerial (10%).

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Berry rot/leaf spot	Phyllosticta elongata	5.0	25.0
Bitter rot	Glomerella cingulata	10.0	10.0
Blotch rot/leaf spot	Physalospora vaccinii	25.0	25.0
Early rot	Phyllosticta vaccinii	100.0	100.0
End rot	Godronia cassandrae var vaccinii	50.0	50.0
Penicillium rot	Penicillium expansum	5.0	15.0

(1) Mathematical relationship between pest density and yield (if known):

Loss is proportional to percent fruit decay at low to moderate levels but may be 100% if decay is above acceptable level.

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicide sprays are used as needed along with late flooding of bogs, sanding bogs with one inch of sand, and the use of resistant cultivars.

f. Alternative fungicides, formulations, rates:

Bravo 720 54L 39-65 oz ai/A
Carbamate WDG 76WP 4.6 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance has developed to mancozeb

b. Management practices using no chemical pesticides:
Late flooding and sanding of bogs

c. Diseases without adequate controls:
Upright dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Cranberry (Vaccinium macrocarpa) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 23,400 2. ACRES HARVESTED: 23,400

3. ACRES TREATED: 2,000 with 3 APPLICATIONS

4. FUNGICIDE maneb

a. Formulations: Manex 37F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Manex 37F 60-84 oz	3	Bloom, plus 2 applic. at 10-14 da intervals

c. Methods of application (% aerial coverage vs blower,irrigation, etc): Ground sprayer or sprinkler (90%), aerial (10%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Berry rot/leaf spot	Phyllosticta putrefaciens	5.0	25.0
Bitter rot	Glomerella cingulata	10.0	10.0
Blotch rot/leaf spot	Physalospora vaccinii	25.0	25.0
Early rot	Guignardia vaccinii	100.0	100.0
Fruit rot	Botrytis cineria	10.0	30.0

(1) Mathematical relationship between pest density and yield (if known):

Loss is proportional to percent fruit decay at low to moderate levels but may be 100% if decay is above acceptable levels.

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicide sprays are used as needed along with late flooding of bogs, sanding bogs with one inch of sand, and the use of resistant cultivars.

f. Alternative fungicides, formulations, rates:

Carbamate WDG 76WP 4.6 lb ai/A
Kocide 101 77WP 6.2 lb ai/A (Not as effective against twig blight)

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to maneb known.

b. Management practices using no chemical pesticides: Late flooding and sanding of bogs

c. Diseases without adequate controls
Upright dieback

Fungicide Benefits on GRAPES
(*Vitis vinifera*, *V. labrusca*, *V. rotundifolia*)

Grapes are grown commercially or in home plantings in all regions of the United States with commercial production in at least 17 states. Nationally, grapes are the highest valued crop of the noncitrus fruit and nut crops with annual production of 5.8 million tons grown on 757,280 acres and valued at $1.36 billion. California produces 86% of the grapes in the U. S. on 653,700 acres with annual production of 5.2 million tons valued at $1.22 billion. The crop in California is grown for making wine (298,900 acres) and raisins (270,700 acres) or for fresh consumption (84,100 acres). Other grape growing states of importance nationally are New York (35,800 acres), Washington (29,200 acres), Michigan (11,100 acres), and Pennsylvania (10,800) (Table 6). In the eastern regions 68,350 acres valued at $71.2 million are grown for processing into various products (juice, jelly, jams, and concentrates), wine production, and a limited amount for fresh consumption.

Grape disease incidence and severity in the more humid eastern states is higher and requires more extensive use of fungicide sprays for control than in the arid western region. Diseases such as powdery mildew and Botrytis bunch rot are prevalent in all regions, affecting from 30%-100% of the acreage with the potential of causing 45%-60% losses if not controlled. At least seven other fungal pathogens producing fruit decay, leaf spots, and cane blights are prevalent in eastern vineyards affecting from 30%-95% of the acreage with potential losses of up to 85%. Control of these diseases requires the use of three to six applications annually in many vineyards. The diversity of pathogen types in many eastern vineyards necessitates the use of fungicides that control the disease complex present. Benomyl was extensively used because of its broad spectrum of disease activity until resistant populations of the pathogens causing powdery mildew and Botrytis bunch rot developed. Mancozeb, ferbam, and captan are very effective against several diseases and are used as companion fungicides in increasing efficacy of the sterol inhibitor fungicides or in delaying resistance development to benomyl, triadimefon, myclobutanil, or fenarimol.

Table 6. Grapes Bearing Acres and Production in the United States by Regions.

State/Region	Bearing Acres-1988	Production Tons
Northeast		
New York	35,800	157,000
Pennsylvania	10,000	58,000
Rhode Island	300	---
Total	46,100	215,000
NorthCentral		
Arkansas	2,200	7,000
Illinois	150	600
Indiana	500	2,250
Michigan	11,100	53,000
Missouri	1,300	3,250
Ohio	1,900	8,900
Total	17,150	75,000
Mid-Atlantic		
Georgia	1,600	2,500
Maryland	600	1,800
New Jersey	1,000	3,000
North Carolina	700	3,300
South Carolina	500	600
Total	4,400	11,200
West		
Arizona	6,730	28,700
California		
All types	653,700	5,240,000
Wine type	298,900	2,130,000
Table type	84,100	700,000
Raisin type	270,700	2,410,000
Washington	29,200	182,000
Total	689,630	5,450,700
Total U.S.	757,280	5,751,900

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia)

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 1,575 with 2-3 APPLICATIONS

4. FUNGICIDE benomyl

a. Formulations: Benlate 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form, Rate (ai/A)	No. of Applications	Timing range or avg.
Benlate 50DF 6-12 oz	2-3	First leaf until berries are full size at 14-21 day intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Angular leaf spot	(Mycosphaerella angulata)	70	20
Bitter rot	(Greeneria uvicola)	20	80
Black rot	(Guignardia bidwellii)	95	85
Botrytis bunch rot	(Botrytis cinerea)	30	60
Eutypa dieback	(Eutypa lata)	75	10
Powdery mildew	(Uncinula necator)	100	45

(1) Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%
Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Captan 50WP 2.0 lb ai/A; Bayleton 50WP 1-3 oz ai/A; Karathane 3-6 oz ai/A; Nova 40WP 1.2-2.0 oz ai/A; Rubigan 12.5EC 0.25-0.75 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to benomyl by the pathogens causing bunch rot, P. mildew, and berry rots have been reported from several regions. Limit applications to 2-3 applications per year.

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia)

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 3,900 with 2-4 APPLICATIONS

4. FUNGICIDE captan

a. Formulations: Captan 50WP or 80WP; Captec 4F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Captan 50WP 2.0 lb	2-4	Just before bloom, plus 2-3 applic. at 10-14 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Black rot	(Guignardia bidwellii)	95	85
Downy mildew	(Plasmopara viticola)	75	40
Phomopsis cane and leaf spot	(Phomopsis viticola)	75	15

(1) Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%
Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:
The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Benlate 50DF 6-12 oz ai/A; Basicop 53WP 17 oz ai/A; Carbamate 76WP 48-60 oz ai/A; Manzate 200 80WP 19-50 oz ai/A; Nova 40WP 1.2-2.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to Captan known.

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 38,800 with 3-4 APPLICATIONS

4. FUNGICIDE copper

a. Formulations: Basicop 53WP (copper sulfate)
Kocide 101 77W; Kocide 606 37.5L (copper hydroxide)

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Basicop 53WP 17oz	3-4	Bloom and post-bloom period at 14 da intervals
Kocide 606 37.5L 16oz	1-2	Late summer sprays

c. Methods of application (% aerial coverage vs blower, irrigation, etc.): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Black rot	(Guignardia bidwelli)	95	85
Downy mildew	(Plasmopara viticola)	75	40
Powdery mildew	(Uncinula necator)	100	45

1. Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%
Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:
The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Benlate 50DF 6-12 oz ai/A; Captan 50WP 2.0 lb ai/A; Manzate 200 80DF 19-50 oz ai/A; Bayleton 50WP 1-2 oz ai/A; Nova 40WP 1.2-2.0 oz ai/A; Thiolux 80DF 75 oz ai/A.

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to copper unknown

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia)

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 1,575 with 3-4 APPLICATIONS

4. FUNGICIDE dinocap

a. Formulations: Karathane WD 19.5WP; Karathane LC 37.4%

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Karathane WD 19.5WP 3-6 oz	3-4	When mildew first appears and repeat at 10-14 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Powdery mildew	(Uncinula necator)	100	45

(1) Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%
Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:
The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Benlate 50DF 6-12 oz ai/A; Bayleton 50WP 1-3 oz ai/A; Nova 40WP 1.2-2.0 oz ai/A; Rubigan 12.5EC 0.25-0.75 oz ai/A; Thiolux 80DF 75 oz ai/A Basicop 53WP 17 oz/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to dinocap known

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia)

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 800 with 4 APPLICATIONS

4. FUNGICIDE fenarimol

a. Formulations: Rubigan 12.5EC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Rubigan 12.5EC 0.25-0.75 oz	4	Pre-bloom, bloom, post-bloom

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Powdery mildew	(Uncinula necator)	100	45

(1) Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%
Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:
The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Bayleton 50WP 1-3 oz ai/A; Benlate 50WP 6-12 oz ai/A; copper 16 oz ai/A; Karathane 19.5WP 3-6 oz zi/A; Thiolux 80DF 75 oz ai/A; Nova 40WP 1.2-2.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to fenarimol known to date but potential for development is great. Use in limited applications or in combination with effective companion fungicide.

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia)

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 38,800 with 3 APPLICATIONS

4. FUNGICIDE ferbam

a. Formulations: Carbamate WDG 76WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Carbamate WDG 76WP 48-60 oz	3	Bloom and Post-bloom

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Black rot	(Guignardia bidwellii)	95	85

(1) Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%
Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:
The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Benlate 50DF 6-12 oz ai/A; Captan 50WP 2.0 lb ai/A; Manzate 200 80DF 19-50 oz ai/A; Nova 40WP 1.2-2.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to ferbam known

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia)

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 7,800 with 2-3 APPLICATIONS

4. FUNGICIDE iprodione

a. Formulations: Rovral 50WP, 4F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Rovral 50WP 12-16 oz	2-3	Bloom, bunch closing, harvest

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Botrytis bunch rot	(Botrytis cinerea)	30	60

(1) Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%
Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:
The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Benlate 6-12 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to iprodione known in some regions. Limit applications to 1-2 applications per season.

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia)

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 69,900 with 4 APPLICATIONS

4. FUNGICIDE mancozeb

a. Formulations: Dithane M-45 80WP; Manzate 200 80DF
Dithane F-45 37F; Pencozeb 80WP or 75DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Manzate 200 80DF 19-50 oz	3-4	During shoot growth development

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Black rot	(Guignardia bidwellii)	95	85
Botrytis bunch rot	(Botrytis cinerea)	30	60
Downy mildew	(Plasmopara viticola)	75	40
Eutypa dieback	(Eutypa lata)	75	10

(1) Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%

Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:
The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Benlate 50DF 6-12 oz ai/A; Captan 50WP 2.0 lb ai/A; Carbamate 76WP 48-60 oz ai/A; Basicop 53WP 17 oz ai/A; Bayleton 50WP 1-3 oz ai/A; Nova 40WP 1.2-2.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to mancozeb known.

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia)

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 23,300 with 3-4 APPLICATIONS

4. FUNGICIDE myclobutanil

a. Formulations: Nova 40WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Nova 40WP 1.2-2.0 oz	3-4	Shoots 1-3" long, and at 10-21 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Black rot	(Guignardia bidwellii)	95	85
Powdery mildew	(Uncinula necator)	100	45

(1) Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%
Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:
The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Bayleton 50WP 1-3 oz ai/A; Benlate 50WP 6-12 oz ai/A; Captan 50WP 2.0 lb ai/A; Carbamate 76WP 48-60 oz ai/A; Karathane 19.5 WD 3-6 oz ai/A; Manzate 200DF 19-50 oz ai/A; Rubigan 12.5EC 0.25-0.75 oz ai/A.

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to myclobutanil known to date but potential for development is great. Use in limited applications or in combination with effective companion fungicide.

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia)

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 19,400 with 6-8 APPLICATIONS

4. FUNGICIDE sulfur

a. Formulations: Thiolux 80DF; Super Six 52L

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Thiolux 80DF 75 oz	6-8	Late dormant thru shoot growth period at 14 da intervals
or		
Super Six 52L	6-8	Same as above

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Powdery mildew	(Uncinula necator)	100	45

(1) Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%
Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:
The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Bayleton 50DF 1-3 oz ai/A; Benlate 50DF 6-12 oz ai/A; Nova 40WP 1.2-2.0 oz ai/A; Karathane 19.5 WD 3-6 oz ai/A; Rubigan 12.5EC 0.25-0.75 oz ai/A; Kocide 606 37.5L 16 oz ai/A.

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to sulfur known.

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

FUNGICIDE BENEFITS REPORT

COMMODITY Grape (Vitis vinifera, V. labrusca, V. rotundifolia)

SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 77,650 2. ACRES HARVESTED: 77,650

3. ACRES TREATED: 54,400 with 3 APPLICATIONS

4. FUNGICIDE triadimefon

a. Formulations: Bayleton 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Bayleton 50DF 1-3 oz	3	Pre-bloom and at 14-21 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Black rot	(Guignardia bidwellii)	95	85
Powdery mildew	(Uncinula necator)	100	45

(1) Mathematical relationship between pest density and yield (if known):

Fruit rot infection = 90%
Leaf spots = 30-40% loss due to fruit quality
Cane infections = proportional to amount of vine loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:
The seasonal application of fungicides are required to control diseases. Annual pruning and removal of diseased parts are helpful in disease control.

f. Alternative fungicides, formulations, rates:
Bayleton 50WP 1-3 oz ai/A; Benlate 50WP 6-12 oz ai/A; Captan 50WP 2.0 lb ai/A; Manzate 200 DF 19-50 oz ai/A; Nova 40WP 1.2-2.0 oz ai/A; Thiolux sulfur 75 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to triadimefon known in some regions. Use in combinations or limit number of applications to 1-2 per season.

b. Management practices using no chemical pesticides: Annual pruning, proper site selection

c. Diseases without adequate controls
Bitter rot, Eutypa dieback

Fungicide Benefits on PEACH/NECTARINE
Peach (Prunus persica) and Nectarine (Prunus persica nectaria)

Peach and nectarine are the third most valued noncitrus fruit or nut crop grown in the United States. Annual production of these crops is 1.4 million tons (fresh equivalent) grown on 190,100 acres and valued at $474 million. They are grown commercially in 21 eastern states with acreage of 105,800 acres and in six western states with 84,300 acres (Table 7). Leading producing states are California (76,500 acres), South Carolina (33,500 acres), Georgia (19,000 acres), New Jersey (11,000 acres), Michigan (7,600 acres), and Pennsylvania (7,600 acres). California produces a major portion of the nectarines (23,600 acres) and cling stone peaches (28,300 acres) grown in the U.S. In the east, 10 mid-Atlantic states produce 84,300 acres, eight northcentral states produce 18,600 acres and 2,900 acres are grown in three northeastern states.

The application of fungicides is necessary in all regions where eight or more fungal and two bacterial pathogens commonly occur. The incidence and severity of each disease varies with the environmental conditions in each region, thus more intensive fungicide usage is essential in the more humid eastern orchards. Brown rot is prevalent in both eastern and western orchards and may produce 75%-90% loss if not controlled. Peach scab incidence varies from 50%-100% in the mid-Atlantic states where losses may be as high as 50%. Two major bacterial diseases that produce branch cankers, defoliation, and fruit spots in some eastern orchards can cause losses of 10%-50% if not controlled.

Fungicide usage programs in the east are designed for control of brown rot, peach scab, powdery mildew, Rhizopus rot, and leaf curl. To control this disease complex, two or more fungicides must be tank mixed and specific fungicides selected for specific disease problems. Protective fungicides such as captan, ferbam, sulfur, and copper may be used for specific diseases, but are more effective against disease complexes if combined with a benzimidazole, dicarboximide, or sterol- inhibitor fungicide. Mixtures are commonly used to delay resistance development as well as to improve efficacy. The control of several diseases require from two to eight fungicide applications annually, but growers seldom use a single fungicide for the entire season. Ferbam, chlorothalonil, and copper are effective against leaf curl and may not be used more than in a single application, although chlorothalonil may be used effectively against brown rot blossom blight if used in two to three applications during bloom. Because of phytotoxicity to leaves this fungicide is not used during the summer sprays.

Table 7. Peach/Nectarine Acres and Production in the United States by Regions

State/Region	Bearing Acres-1988	Production Million lb. 1988
Northeast		
Connecticut	500	2.7
Massachusetts	300	2.2
New York	2,100	14.1
Total	2,900	19.0
NorthCentral		
Arkansas	1,900	20.0
Illinois	2,300	20.0
Indiana	1,100	4.5
Kansas	900	4.5
Kentucky	1,200	6.0
Michigan	7,600	45.0
Missouri	2,700	14.4
Ohio	900	6.0
Total	18,600	120.4
Mid-Atlantic		
Delaware	300	3.1
Georgia	19,000	140.0
Maryland	2,500	12.8
New Jersey	11,000	85.0
North Carolina	3,400	36.0
Pennsylvania	7,600	85.0
South Carolina	33,500	340.0
Tennessee	1,500	11.0
Virginia	2,300	29.0
West Virginia	3,200	20.0
Total	84,300	761.9
West		
California		
Clingstone	28,300	1015.0
Freestone	24,600	523.0

Nectarine	23,600	400.0
Colorado	1,500	16.0
Idaho	700	11.8
Oregon	1,400	14.0
Utah	1,600	11.0
Washington	2,600	50.0
Total	84,300	2,040.8
Total U.S.	190,100	2,942.1

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 26,450 with 2-4 APPLICATIONS

35,000 with 1-2 APPLICATIONS

4. FUNGICIDE benomyl

a. Formulations: Benlate 50WP or 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Benlate 50DF 5-8 oz plus Captan 50WP 16-24 oz	1-4	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	75.0
Botrytis rot	Botrytis cinerea	5.0	5.0
Peach Scab	Cladosporium carpophilum	100.0	50.0
Powdery mildew	Sphaerotheca pannosa	5.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Topsin M 70WP oz/A plus
Captan 50WP 16-24 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Brown rot resistance to benomyl is common in many regions. Combination of benomyl plus captan or other chemically unrelated fungicide recommended. Limit number of applications to 2-3 per year.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls

Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 89,900 with 2-4 APPLICATIONS

35,300 with 4-8 APPLICATIONS

4. FUNGICIDE captan

a. Formulations: Captan 50WP or 80WP; Captec 4F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Captan 50WP 2.5-3.0 lb or	4-8	bloom thru harvest periods
Captan 50WP 1.0 -1.5 lb plus benomyl, thiophanate methyl or SBI fungicides	2-4	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	75.0
Botrytis rot	Botrytis cinerea	5.0	5.0
Peach Scab	Cladosporium carpophilum	100.0	50.0
Rhizopus rot	Rhizopus nigricans	100.0	20.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Ronilan 50WP 8-16 oz ai/A
Rovral 50WP 8-16 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to captan known. Captan is used as a companion fungicide with benomyl, thiophanate methyl, or SBI fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 21,200 with 2 APPLICATIONS

4. FUNGICIDE chlorothalonil

a. Formulations: Bravo 720 54LC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Bravo 720 54LC 27-36 oz	2 (scab)	bloom and shuck-split
	1 (leaf curl)	dormant (Fall or Spring)

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Peach leaf curl	Taphrina deformans	50.0	25.0
Peach Scab	Cladosporium carpophilum	100.0	50.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Carbamate WDG 76WP 46 oz ai/A (leaf curl)
Captan 50WP 40-48 oz ai/A (scab)

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to chlorothalonil reported to date.
Possible resistance development may be avoided by using limited applications per season or used in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls

Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 5,300 with 1 APPLICATIONS

4. FUNGICIDE copper

a. Formulations: Basicop 53WP (Copper sulfate)
Kocide 101 77W; Kocide 606 37.5L (Copper hydroxide)

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Basicop 53WP 34-42 oz	1-2	dormant, Pink
Kocide 101 77W 6.0 lb	1-2	dormant, Pink

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bacterial Canker	Pseudomonas syringae	50.0	5.0-10.0
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0
Peach leaf curl	Taphrina deformans	50.0	25.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Carbamate WDG 76WP 46 oz ai/A (for leaf curl)

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to copper reported to date.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls

Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 5,300 with 1-2 APPLICATIONS

4,500 with 1 APPLICATIONS (post-harvest)

4. FUNGICIDE dicloran

a. Formulations: Botran 75WP

b. Federal/State recommendations or guidelines:

Fungicide, Form, Rate (ai/A)	No. of Applications	Timing range or avg.
Botran 75WP 16 oz	1-2	bloom, harvest
Botran 75WP 12 oz/100 gal	1	post-harvest dip

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	75.0
Rhizopus rot	Rhizopus nigricans	100.0	20.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Captan 50WP 16 oz ai/100 gal

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to dicloran reported to date.
Possible resistance development may be avoided by using limited applications per season or used in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 5,300 with 1-5 APPLICATIONS

4. FUNGICIDE dodine

a. Formulations: Dodine 65WP; Syllit 4F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Dodine 65WP 26 oz plus Captan 50WP 16-24 oz	1-5	Post-bloom to post-harvest

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bacterial Spot	Xanthomonas campestris cv prunii	50.0	8.0-10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Mycoshield 17WP 5.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to dodine reported to date.
Possible resistance development may be avoided by using limited applications per season or used in combinations with chemically, unrelated fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls

Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 63,400 with 1 APPLICATIONS

4. FUNGICIDE ferbam

a. Formulations: Carbamate WDG 46 oz

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Carbamate WDG 76WP 46 oz	1	dormant (Spring or Fall)

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Peach leaf curl	Taphrina deformans	50.0	25.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Bravo 720 5LC 27-36 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to ferbam reported to date.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED 26,450 with 2-3 APPLICATIONS

4. FUNGICIDE iprodione

a. Formulations: Rovral 50WP

b. Federal/State recommendations or guidelines:

Fungicide, Form.	Rate (ai/A)	No. of Applications	Timing range or avg.
Rovral 50WP	8-16 oz	2-4	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom rot	(Monilinia fructicola or M. laxa)	80.0	10.0
Brown rot fruit	(Monilinia fructicola or M. laxa)	100.0	75.0

1. Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Captan 50WP 40-48 oz ai/A
Ronilan 50WP 8-16 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES

a. Resistance management: No resistance to Rovral in most regions, but has been reported in isolated orchards. Ronilan should be used in limited applications per season or in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 31,700 with 2-5 APPLICATIONS

4. FUNGICIDE oxytetracycline

a. Formulations: Mycoshield 17WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Mycoshield 17WP 5.0 oz	2-5	Shuck-split followed by weekly applications

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bacterial Spot	Xanthomonas campestria cv prunii	50.0	20.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:
None

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Possible resistance development may be avoided by using limited applications per season.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 95,220 with 4-8 APPLICATIONS

4. FUNGICIDE sulfur

a. Formulations: Sulfur Spray APK 83WP; Thiolux 80DF; Super Six 52L

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Sulfur Spray APK 83WP 12.5 lb	4-8	bloom thru harvest

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	(Monilinia fructicola or M. laxa)	80.0	10.0
Peach Scab	(Cladosporium carpophilum)	100.0	50.0
Powdery mildew	(Sphaerotheca pannosa)	5.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Benlate 50WP 10 oz ai/A
Topsin M 70WP 14 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to sulfur reported to date.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 26,450 with 1-2 APPLICATIONS

4. FUNGICIDE thiophanate methyl

a. Formulations: Topsin M 70WP; Topsin M 4.5F 46F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Topsin M 70WP 7-14 oz plus Captan 50WP 16-24 oz	1-2	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	(Monilinia fructicola or M. laxa)	80.0	10.0
Brown rot fruit	(Monilinia fructicola or M. laxa)	100.0	75.0
Botrytis rot	(Botrytis cinerea)	5.0	5.0
Peach Scab	(Cladosporium carpophilum)	100.0	50.0
Powdery mildew	(Sphaerotheca pannosa)	5.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Benlate 50DF 5-8 oz plus
Captan 50WP 16-24 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Brown rot resistance to thiophanate methyl is common in many regions. Combination of benomyl plus captan or other chemically unrelated fungicide recommended. Limit number of applications to 2-3 per year.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls

Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 4,300 with 2-3 APPLICATIONS

4. FUNGICIDE thiram

a. Formulations: Thiram 65WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Thiram 65WP 52-62 oz	2-3	bloom period

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	(Monilinia fructicola or M. laxa)	80.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Captan 50WP 40-48 oz ai/A
Ziram 76WDG 60-73 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to thiram reported to date.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 63,500 with 1-3 APPLICATIONS

4. FUNGICIDE triforine

a. Formulations: Funginex 1.6EC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Funginex 18.2%EC 6.5-8.7 oz	1-3	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	(Monilinia fructicola or M. laxa)	80.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:
Benlate 50DF 5-8 oz + Captan 50WP 16-24 oz ai/A
Captan 50WP 40-48 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to triforine reported to date. Possible resistance development may be avoided by using limited applications per season or used in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 26,450 with 2-3 APPLICATIONS

4. FUNGICIDE vinclozolin

a. Formulations: Ronilan 50WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Ronilan 50WP 8-16 oz	2-4	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	75.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Captan 50WP 40-48 oz ai/A
Rovral 50WP 8-16 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to Ronilan in most regions but has been reported in isolated orchards. Rovral should be used in limited applications per season or in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot, rust spot (P. mildew)

FUNGICIDE BENEFITS REPORT

COMMODITY Peach/Nectarine SUB-COMMODITY Peach (Prunus persica)
Nectarine (Prunus persica var nectaria)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 105,800 2. ACRES HARVESTED: 105,800

3. ACRES TREATED: 4,300 with 2-3 APPLICATIONS

4. FUNGICIDE ziram

a. Formulations: Ziram 76WDG 76WP; Ziram F-4 40F

b. Federal/State recommendations or guidelines:

Fungicide, Form, Rate (ai/A)	No. of Applications	Timing range or avg.
Ziram 76WDG 60-73 oz	2-3	bloom period

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	(Monilinia fructicola or M. laxa)	80.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Captan 50WP 40-48 oz ai/A
Thiram 50WP 52-62 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to ziram reported to date.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot, rust spot (P. mildew)

Fungicide Benefits on PEAR (*Pyrus communis*)

Pear production in the United States is about 934,000 tons produced on 69,600 acres, 90% of which is located in the western states of California, Oregon, and Washington. In the east, commercial pear Production is limited to relatively few states with 5,800 acres being grown in Michigan, New York, and Pennsylvania (Table 8). Fireblight, a bacterial disease, is a major limiting factor in pear production since most cultivars are susceptible to moderate to severe damage when infection occurs. It is favored by warm humid conditions and for this reason pears are not grown commercially in eastern states south of Pennsylvania.

The control of fireblight requires the use of cultural practices which are carefully balanced along with specifically timed applications of streptomycin during and after bloom. Control in some northcentral orchards has been difficult to maintain due to development of streptomycin-resistant strains of the pathogen. Other fungal diseases of importance in eastern orchards include pear scab, Fabraea spot, sooty blotch, and fly speck which either deforms or blemishes fruit or defoliates the tree. Their control is dependent on fungicide applications during the post-bloom period. Fungicides most commonly used are ferbam, ziram, fenarimol, or a combination of benomyl with ferbam or ziram. With the recent loss of registration of captan and benomyl (for post-harvest disease control) the control of pathogens causing decay of fruit before and after harvest is of major concern to growers. Ferbam and ziram have low efficacy levels against black rot, bitter rot, and blue mold.

Table 8. All Pears Bearing Acres and Production in the United States by Regions.

State/Region	Bearing Acres-1988	Production Tons
Northeast		
Connecticut	400	1,650
New York	2,800	17,300
Total	3,200	18,950
NorthCentral		
Michigan	1,500	8,000
Total	1,500	8,000
Mid-Atlantic		
Pennsylvania	1,100	3,200
Total	1,100	3,200
West		
California	22,400	303,000
Colorado	700	3,800
Oregon	16,900	225,000
Utah	400	2,000
Washington	23,400	370,000
Total	63,800	903,800
Total U.S.	69,600	933,950

FUNGICIDE BENEFITS REPORT

COMMODITY Pear (Pyrus communis) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5,800 2. ACRES HARVESTED: 5,800

3. ACRES TREATED: 5,220 with 3-9 APPLICATIONS

4. FUNGICIDE benomyl

a. Formulations: Benlate 50WP or 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Benlate 50DF 3.0-6.0 oz plus Mancozeb fungicide 30-38 oz or Ziram fungicide 48-72 oz	7-9	Green-tip thru 6th Cover
Same combinations above	3-5	White-bud thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Fly speck	Zygophiala jamicensis	40.0	40.0
Pear Scab	Venturia pirina	80.0	85.0
Powdery mildew	Podosphaera leucotricha	10.0	15.0
Sooty blotch	Gloeodes pomigena	50.0	60.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Scab and deformed = 95% loss
Fruit blemishes = 60% loss
Cankers = Loss proportional to limbs lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size

f. Alternative fungicides, formulations, rates:

none

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Pear scab resistance is present or a threat in many pear growing regions. Benomyl must be used in combination with mancozeb, ferbam, or ziram to avoid resistance development. Limit application numbers to 3-5 per year.

b. Management practices using no chemical pesticides:
Not likely to be able to grow pears without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, bitter rot, and Post-harvest rots

FUNGICIDE BENEFITS REPORT

COMMODITY Pear (Pyrus communis) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5,800 2. ACRES HARVESTED: 5,800

3. ACRES TREATED: 900 with 1-2 APPLICATIONS (fall or spring)

2,320 with 2 APPLICATIONS (bloom time)

4. FUNGICIDE copper

a. Formulations:
Kocide 101 77W (cupric hydroxide)
Kocide 606 37.5WP (cupric hydroxide)
COCS 50WP (from copper oxychloride and basic copper sulfate)

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Kocide 606 37.5WP 48-128 oz	1-2	fall or spring
or		
COCS 50WP 2.0 oz	2	during bloom

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Fireblight	Erwinia amylovora	90.0	100.0
Phytophthora collar/ crown rot	Phytophthora cactorum	15.0	60.0

(1) Mathematical relationship between pest density and yield (if known):

Death of trees = 70%-90% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water

for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Ridomil 2E 25EC 64-128 fl oz (non bearing trees)
streptomycin 17WP 100ppm

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to copper known for pear pathogens.

b. Management practices using no chemical pesticides:
Not likely to be able to grow pears commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, bitter rot, and Post-harvest rots.

FUNGICIDE BENEFITS REPORT

COMMODITY Pear (Pyrus communis) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5,800 2. ACRES HARVESTED: 5,800

3. ACRES TREATED: 4,060 with 4-6 APPLICATIONS

4. FUNGICIDE fenarimol

a. Formulations: Rubigan 12.5EC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Rubigan 1E 0.75-1.5 oz	6-8	Green-tip thru 3rd Cover
or		
Rubigan 1E 0.5-0.75 oz plus mancozeb or ziram	6-8	Green-tip thru 3rd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Pear Scab	Venturia pirina	80.0	85.0
Powdery mildew	Podosphaera leucotricha	10.0	15.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size

f. Alternative fungicides, formulations, rates:

None

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known in pear pathogens, but the probability exists unless fenarimol is used in combination with unrelated fungicide such as mancozeb or ziram.

b. Management practices using no chemical pesticides:
Not likely to be able to grow pears without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, bitter rot, and Post-harvest rots

FUNGICIDE BENEFITS REPORT

COMMODITY Pear (Prunus communis) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5,800 2. ACRES HARVESTED: 5,800

3. ACRES TREATED: 1,740 with 4 APPLICATIONS

3,000 with 3 APPLICATIONS

4. FUNGICIDE ferbam

a. Formulations: Carbamate WDG 76WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Carbamate WDG 76WP 48-72 oz	4	White-bud - 2nd Cover
or		
Carbamate WDG 76WP 48 oz	3	3rd Cover thru 6th Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 99% vs aerial 1.0%

d. Diseases subject to control:

Commmon Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bitter rot	Glomerella cingulata	10.0	60.0
Black rot	Botryosphaeria obtusa	60.0	75.0
Fly speck	Zygophiala jamicensis	40.0	40.0
Pear Scab	Venturia pirina	80.0	85.0
Sooty blotch	Gloeodes pomigena	50.0	60.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Blotches and blemishes = 50% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size

f. Alternative fungicides, formulations, rates:

mancozeb 38-102 oz ai/A
Ziram 48-146 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known to ferbam.

b. Management practices using no chemical pesticides:
Not likely to be able to grow pears without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, bitter rot, and Post-harvest rots

FUNGICIDE BENEFITS REPORT

COMMODITY Pear (Pyrus communis) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5,800 2. ACRES HARVESTED: 5,800

3. ACRES TREATED: 5,000 with 3-6 APPLICATIONS (fall or spring)

4. FUNGICIDE streptomycin sulfate

a. Formulations:

Agri-Strep Type D 21.2%WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Agri-Strep 21WP 5-10 oz	3-6	During bloom and immed. post-bloom

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Fireblight	Erwinia amylovora	90.0	100.0

(1) Mathematical relationship between pest density and yield (if known):

Death of trees = 70%-90% loss
Cankers = Proportioned to branches lost, probable 70% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal bactericidal sprays used when necessary along with pruning and adequate fertilization for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

copper fungicides 48-128 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to streptomycin known to exist in several orchards in Missouri and may be present in others. Limiting applications to times most needed is the most effective method of avoiding tolerance development

b. Management practices using no chemical pesticides:
Not likely to be able to grow pears commercially without fireblight control.

c. Diseases without adequate controls
Canker blight and terminal blight (fireblight)

FUNGICIDE BENEFITS REPORT

COMMODITY Pear (Pyrus communis) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5,800 2. ACRES HARVESTED: 5,800

3. ACRES TREATED: 600 with 2-5 APPLICATIONS

4. FUNGICIDE triadimefon

a. Formulations:
Bayleton 50WP, Bayleton 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Bayleton 50WP 1.0-4.0 oz	2-5	Tight-cluster thru 3rd Cover (maximum 12 oz ai/A/season)

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Powdery mildew	Podosphera leucotricha	10.0	15.0

(1) Mathematical relationship between pest density and yield (if known):

Blotches and blemishes = 50% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:

Rubigan 12.5EC 0.75-1.5 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance known in pear pathogens, but the probability exists unless triadimefon is used in combination with an unrelated fungicide such as sulfur.

b. Management practices using no chemical pesticides:
Not likely to be able to grow pears commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, bitter rot, and post-harvest rots.

FUNGICIDE BENEFITS REPORT

COMMODITY Pear (Pyrus communis) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 5,800 2. ACRES HARVESTED: 5,800

3. ACRES TREATED:

Has not been recommended in the East until 1990

4. FUNGICIDE ziram

a. Formulations:
Ziram 76 WDG

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Ziram 76WDG 73-146 oz	5-7	Green-tip thru 6th Cover
Ziram 76WDG 48-72 oz plus benomyl, SBI fungicides	5	Tight-cluster thru 2nd Cover

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground cover, 99% vs aerial 1.0%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Pear Scab	Venturia pirina	80.0	85.0

(1) Mathematical relationship between pest density and yield (if known):

Fresh fruit - scab infected = 100% loss
Processed fruit - scab infected = 40% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal fungicide usage is necessary along with pruning, weed control, and adequate water for tree growth and fruit size.

f. Alternative fungicides, formulations, rates:
mancozeb fungicides 38-102 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to ziram known. Ziram is used alone or in companion with benomyl or fenarimol fungicides to avoid resistance development.

b. Management practices using no chemical pesticides:
Not likely to be able to grow pears commercially without pesticides.

c. Diseases without adequate controls
Canker phase of black rot, white rot, bitter rot, and post-harvest rots.

Fungicide Benefits on PLUMS (*Prunus salicina*) and PRUNES (*Prunus domestica*)

The major plum and prune producing area of the United States is in the western states of California, Oregon, Washington, and Idaho (Table 9). California is the major producer of both plums (40,000 acres) and prunes (75,800) with annual production of 216,000 tons of plums and 155,000 tons of prunes. California produces 88% of the annual national production of these crops. The relatively small amount grown in the eastern states (11,775 tons) is centered in Michigan (2,800 acres) with only a few hundred acres in other eastern states. Both plums and prune-type plums grown in the east are produced for canning and fresh consumption and not for dried prune production.

Brown rot is the major disease in eastern orchards and fungicide sprays are required for control. Sprays must be applied during the blossoming period when rain periods occur and during harvest to protect ripening fruit. Development of resistant strains of this pathogen to the benzimidazole and dicarboximide fungicides is a high probability unless combinations of chemically unrelated companion fungicides are used. In addition to brown rot six other fungal and two bacterial diseases require regular or sporadic use of chemical sprays to prevent economic losses. Black knot is the second most important fungal disease causing destruction to twigs and branches. Most registered fungicides for use on plums are ineffective against black knot or their effectivity is unknown. The registered fungicides most commonly used in plums and prunes include benomyl, captan, chlorothalonil, iprodione, vinclozolin, sulfur, and triforine.

Table 9. Prunes and Plums Bearing Acres and Production in the United States by Regions.

State/Region	Bearing Acres-1988	Production Tons
NorthCentral		
Michigan	2,800	11,800
Total	2,800	11,800
West		
California	115,800	371,000
Idaho	900	6,500
Oregon	4,300	21,000
Washington	1,500	13,500
Total	122,500	412,000
Total U.S.	125,300	423,800

FUNGICIDE BENEFITS REPORT

COMMODITY Plums/Prunes SUB-COMMODITY Plum (*Prunus salicina*)
Prune (*Prunus domestica*)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 2,300 2. ACRES HARVESTED: 2,300

3. ACRES TREATED: 500 with 2-4 APPLICATIONS

4. FUNGICIDE benomyl

a. Formulations: Benlate 50WP or 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Benlate 50DF 5-8 oz plus Captan 50WP 16-24 oz	1-4	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	*Monilinia fructicola* or *M. laxa*	80.0	10.0
Brown rot fruit	*Monilinia fructicola* or *M. laxa*	100.0	75.0
Botrytis rot	*Botrytis cinerea*	10.0	15.0
Plum Scab	*Cladosporium carpophilum*	2.0	5.0
Powdery mildew	*Sphaerotheca pannosa*	10.0	5.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Topsin M 70WP oz/A plus
Captan 50WP 16-24 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Brown rot resistance to benomyl is common in many regions. Combination of benomyl plus captan or other chemically unrelated fungicide recommended. Limit number of applications to 2-3 per year.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls

Cytospora canker, bacterial spot

FUNGICIDE BENEFITS REPORT

COMMODITY Plums/Prunes SUB-COMMODITY Plum (Prunus salicina)
Prune (Prunus domestica)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 2,300 2. ACRES HARVESTED: 2,300

3. ACRES TREATED: 1,000 with 2-4 APPLICATIONS

4. FUNGICIDE captan

a. Formulations: Captan 50WP or 80WP; Captec 4F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Captan 50WP 2.5-3.0 lb or	4-8	bloom thru harvest periods
Captan 50WP 1.0-1.5 lb plus benomyl, thiophanate methyl or SBI fungicides	2-4	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	75.0
Botrytis rot	Botrytis cinerea	10.0	15.0
Plum scab	Cladosporium carpophilum	2.0	5.0
Rhizopus rot	Rhizopus nigricans	20.0	30.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Ronilan 50WP 8-16 oz ai/A
Rovral 50WP 8-16 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to captan known. Captan is used as a companion fungicide with benomyl, thiophanate methyl, or SBI fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls

Cytospora canker, bacterial spot

FUNGICIDE BENEFITS REPORT

COMMODITY Plums/Prunes SUB-COMMODITY Plum (Prunus salicina)
Prune (Prunus domestica)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 2,300 2. ACRES HARVESTED: 2,300

3. ACRES TREATED: 1,000 with 2 APPLICATIONS

4. FUNGICIDE chlorothalonil

a. Formulations: Bravo 720 54LC

b. Federal/State recommendations or guidelines:

Fungicide, Form, Rate (ai/A)	No. of Applications	Timing range or avg.
Bravo 720 54LC 27-36 oz	2 (scab)	bloom and shuck-split
	1 (leaf curl)	dormant (Fall or Spring)

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Peach leaf curl	Taphrina deformans	50.0	25.0
Peach scab	Cladosporium carpophilum	2.0	5.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss

Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Carbamate WDG 76WP 46 oz ai/A (leaf curl)

Captan 50WP 40-48 oz ai/A (scab)

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to chlorothalonil reported to date. Possible resistance development may be avoided by using limited applications per season or used in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls

Cytospora canker, bacterial spot

FUNGICIDE BENEFITS REPORT

COMMODITY Plums/Prunes SUB-COMMODITY Plum (Prunus salicina)
Prune (Prunus domestica)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 2,300 2. ACRES HARVESTED: 2,300

3. ACRES TREATED: 500 with 1 APPLICATIONS

4. FUNGICIDE copper

a. Formulations: Basicop 53WP (Copper sulfate)
Kocide 101 77W; Kocide 606 37.5L (Copper hydroxide)

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Basicop 53WP 34-42 oz	1-2	dormant, Pink
Kocide 101 77W 6.0 lb	1-2	dormant, Pink

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Bacterial Canker	Pseudomonas syringae	50.0	5.0-10.0
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0
Peach leaf curl	Taphrina deformans	50.0	25.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Carbamate WDG 76WP 46 oz ai/A (for leaf curl)

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to copper reported to date.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls

Cytospora canker, bacterial spot

FUNGICIDE BENEFITS REPORT

COMMODITY Plums/Prunes SUB-COMMODITY Plum (Prunus salicina)
Prune (Prunus domestica)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 2,300 2. ACRES HARVESTED: 2,300

3. ACRES TREATED: 800 with 1-2 APPLICATIONS

4. FUNGICIDE dicloran

a. Formulations: Botran 75WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Botran 75WP 16 oz	1-2	bloom, harvest
Botran 75WP 12 oz/100 gal	1	post-harvest dip

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	75.0
Rhizopus rot	Rhizopus nigricans	20.0	30.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Captan 50WP 16 oz ai/100 gal

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to dicloran reported to date.
Possible resistance development may be avoided by using limited applications per season or used in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls

Cytospora canker, bacterial spot

FUNGICIDE BENEFITS REPORT

COMMODITY Plums/Prunes SUB-COMMODITY Plum (*Prunus salicina*)
Prune (*Prunus domestica*)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 2,300 2. ACRES HARVESTED: 2,300

3. ACRES TREATED: 1,000 with 2-3 APPLICATIONS

4. FUNGICIDE iprodione

a. Formulations: Rovral 50WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Rovral 50WP 8-16 oz	2-4	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	*Monilinia fructicola* or *M. laxa*	80.0	10.0
Brown rot fruit	*Monilinia fructicola* or *M. laxa*	100.0	75.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Captan 50WP 40-48 oz ai/A
Ronilan 50WP 8-16 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to Rovral in most regions, but has been reported in isolated orchards. Ronilan should be used in limited applications per season or in combination with chemically unrelated fungicides

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot

FUNGICIDE BENEFITS REPORT

COMMODITY Plums/Prunes SUB-COMMODITY Plum (Prunus salicina)
Prune (Prunus domestica)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 2,300 2. ACRES HARVESTED: 2,300

3. ACRES TREATED: 500 with 4-8 APPLICATIONS

4. FUNGICIDE sulfur

a. Formulations: Sulfur Spray APK 83WP; Thiolux 80DF; Super Six 52L

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Sulfur Spray APK 83WP 12.5 lb	4-8	bloom thru harvest

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0
Plum scab	Cladosporium carpophilum	2.0	5.0
Powdery mildew	Sphaerotheca pannosa	10.0	5.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Benlate 50WP 10 oz ai/A
Topsin M 70WP 14 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to sulfur reported to date.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot

FUNGICIDE BENEFITS REPORT

COMMODITY Plums/Prunes SUB-COMMODITY Plum (Prunus salicina)
Prune (Prunus domestica)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 2,300 2. ACRES HARVESTED: 2,300

3. ACRES TREATED: 500 with 1-2 APPLICATIONS

4. FUNGICIDE thiophanate methyl

a. Formulations: Topsin M 70WP; Topsin M 4.5F 46F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Topsin M 70WP 7-14 oz plus Captan 50WP 16-24 oz	1-2	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	(Monilinia fructicola or M. laxa)	80.0	10.0
Brown rot fruit	(Monilinia fructicola or M. laxa)	100.0	75.0
Botrytis rot	(Botrytis cinerea)	10.0	15.0
Plum scab	(Cladosporium carpophilum)	2.0	5.0
Powdery mildew	(Sphaerotheca pannosa)	10.0	5.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Benlate 50DF 5-8 oz plus
Captan 50WP 16-24 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Brown rot resistance to thiophanate methyl is common in many regions. Combination of benomyl plus captan or other chemically unrelated fungicide recommended. Limit number of applications to 2-3 per year.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot

FUNGICIDE BENEFITS REPORT

COMMODITY Plums/Prunes SUB-COMMODITY Plum (Prunus salicina)
Prune (Prunus domestica)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 2,300 2. ACRES HARVESTED: 2,300

3. ACRES TREATED: 1,500 with 1-3 APPLICATIONS

4. FUNGICIDE triforine

a. Formulations: Funginex 1.6EC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Funginex 18.2%EC 6.5-8.7 oz	1-3	bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:
Benlate 50DF 5-8 oz + Captan 50WP 16-24 oz ai/A
Captan 50WP 40-48 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to triforine reported to date. Possible resistance development may be avoided by using limited applications per season or used in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot

FUNGICIDE BENEFITS REPORT

COMMODITY Plums/Prunes SUB-COMMODITY Plum (Prunus persica)
Prune (Prunus domestica)

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 2,300 2. ACRES HARVESTED: 2,300

3. ACRES TREATED: 500 with 2-3 APPLICATIONS

4. FUNGICIDE vinclozolin

a. Formulations: Ronilan 50WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Ronilan 50WP 8-16 oz	2-4	Green-tip, bloom and harvest periods

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer (98%) vs aerial (2%)

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown rot blossom blight	Monilinia fructicola or M. laxa	80.0	10.0
Brown rot fruit	Monilinia fructicola or M. laxa	100.0	75.0

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Deformed fruit = 80% loss
Fruit blemishes or reduced size = 40-60% loss

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Seasonal applications (5-10) of fungicides are necessary to protect tree and fruit from infection by 3-5 major fungal pathogens. Disease control also received annual pruning, weed control, fertilization and sufficient water to prevent stress to trees.

f. Alternative fungicides, formulations, rates:

Captan 50WP 40-48 oz ai/A
Rovral 50WP 8-16 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to Ronilan in most regions but has been reported in isolated orchards. Rovral should be used in limited applications per season or in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Pruning trees annually, weed control under trees, proper fertilization and moisture levels to prevent tree stress.

c. Diseases without adequate controls
Cytospora canker, bacterial spot

Fungicide Report on STRAWBERRY (Fragaria virginiana)

Strawberries are grown commercially throughout the United States with an estimated 55,000 acres valued at $1.2 billion. Acreage and production data are not well recorded, and since strawberries are a favorite home garden crop it is likely that the national production is 10%-20% higher than the estimates. Commercial production is similar in both eastern and western regions. In the eastern region production is estimated at 5,600 acres in five northeastern states, 9,500 acres in six northcentral states, and 14,800 acres in 11 southeastern states. Acreage estimates for each eastern state ranges from 300 to 2,500 acres with many states producing 1,000 acres or more.

Eight to ten fungal diseases are common to strawberry production in all regions. Fruit rot caused by Botrytis cinerea is the most prevalent disease affecting all plantings when frequent rain periods occur during harvest. Other fungi causing fruit rot, leaf spots and powdery mildew are present in 15%-35% of the eastern acreage where each disease may produce losses of 5%-45% if not properly controlled. Fungicide sprays applied in 2-5 applications are commonly used to protect leaves and fruit from infections. Control measures other than fungicide applications used by growers include the use of resistant cultivars, straw mulch to protect fruit from contact with the soil, weed control to increase rapid drying of leaves and fruit, and adequate use of irrigation to prevent moisture stress. Additionally, control of several diseases is improved through annual renovation of beds which destroys disease inoculum, and the practice of planting on raised beds eliminates flooding of plants and encourages rapid drying.

Fungicides most commonly used are captan, benomyl, and vinclozolin because they are highly effective against several diseases and can be used near the time of harvest. Other registered fungicides include copper, thiophanate methyl, thiram, and ziram have received only limited usage because of level of efficacy, phytotoxicity, or cost to apply.

FUNGICIDE BENEFITS REPORT

COMMODITY Strawberry (Fragaria virginiana) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 29,900 2. ACRES HARVESTED: 29,000

3. ACRES TREATED: 13,950 with 2-5 APPLICATIONS

4. FUNGICIDE benomyl

a. Formulations: Benlate 50DF

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Benlate 50DF 4-8 oz	2-5	Bloom, Post-bloom at 10-14 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers 95% vs irrigation 5%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Anthracnose fruit rot	(Colletotrichum dematium) (C. fragariae) (Gloeosporium gloeosporiodes)	20	15
Gray mold	(Botrytis cinerea)	100	45
Leaf blight and crown rot	(Rhizoctonia bataticola)	10	25
Leaf scorch	(Diplocarpon earliana)	35	5
Leaf spot	(Mycosphaerella fragariae, (Septiria fragariae)	35	20
Powdery mildew	(Sphaerotheca macularis)	15	10

(1) Mathematical relationship between pest density and yield (if known):
Decayed fruit = 100% loss
Leaf spots = 30% loss to fruit size and quality

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicides required to control fruit decay pathogens; straw mulch used to protect berries from contact with soil; irrigation used to provide water to prevent moisture stress.

f. Alternative fungicides, formulations, rates:
captan 50WP 3.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to benomyl reported in several regions. Resistance development can be delayed by using in combination with chemically unrelated fungicides or by limiting the number of applications per season.

b. Management practices using no chemical pesticides: Annual removal or renovation of beds which destroys diseased parts; Raised beds eliminates flooding and encourages rapid drying. Use of resistant cultivars

c. Diseases without adequate controls
Red stele root rot and other root rots

FUNGICIDE BENEFITS REPORT

COMMODITY Strawberry (Fragaria virginiana) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 29,900 2. ACRES HARVESTED: 29,000

3. ACRES TREATED: 23,700 with 3-5 APPLICATIONS

4. FUNGICIDE captan

a. Formulations: Captan 50WP; Captec 4F

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Captan 50WP 3.0 lb	3-5	Bloom, Post-bloom at 12-14 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers 95% vs irrigation 5%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Gray mold	(Botrytis cinerea)	100	45
Leaf spot	(Mycosphaerella fragariae	35	20
	(Septiria fragariae)		

1) Mathematical relationship between pest density and yield (if known):
Decayed fruit = 100% loss
Leaf spots = 30% loss to fruit size and quality

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicides required to control fruit decay pathogens; straw mulch used to protect berries from contact with soil; irrigation used to provide water to prevent moisture stress.

f. Alternative fungicides, formulations, rates:
Benlate 50DF 4-8 oz ai/A; Ronilan 50WP 12-16 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to captan reported

b. Management practices using no chemical pesticides: Annual removal or renovation of beds which destroys diseased parts; Raised beds eliminates flooding and encourages rapid drying. Use of resistant cultivars

c. Diseases without adequate controls
Red stele root rot and other root rots

FUNGICIDE BENEFITS REPORT

COMMODITY Strawberry (Fragaria virginiana) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 29,900 2. ACRES HARVESTED: 29,000

3. ACRES TREATED: 300 with 1-2 APPLICATIONS

4. FUNGICIDE copper

a. Formulations: Basicop 53WP (copper sulfate)
Kocide 101 77WP (copper hydroxide)

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Kocide 101 77WP 24-36 oz	1-2	Pre-bloom and post-harvest

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers 95% vs irrigation 5%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Leaf blight and crown rot	(Rhizoctonia bataticola)	10	25
Leaf spot	(Mycosphaerella fragariae, (Septiria fragariae)	35	20

(1) Mathematical relationship between pest density and yield (if known):
Decayed fruit = 100% loss
Leaf spots = 30% loss to fruit size and quality

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicides required to control fruit decay pathogens; straw mulch used to protect berries from contact with soil; irrigation used to provide water to prevent moisture stress.

f. Alternative fungicides, formulations, rates:
none

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to copper not known.

b. Management practices using no chemical pesticides: Annual removal or renovation of beds which destroys diseased parts; Raised beds eliminates flooding and encourages rapid drying. Use of resistant cultivars

c. Diseases <u>without</u> adequate controls
Red stele root rot and other root rots

FUNGICIDE BENEFITS REPORT

COMMODITY Strawberry (Fragaria virginiana) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 29,900 2. ACRES HARVESTED: 29,000

3. ACRES TREATED: 4,185 with 1-3 APPLICATIONS

4. FUNGICIDE thiophanate methyl

a. Formulations: Topsin M 70WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Topsin M 70WP 12 oz	1-3	Bloom, Post-bloom at 7-10 da intervals through harvest

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers 95% vs irrigation 5%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Gray mold	(Botrytis cinerea)	100	45
Leaf blight and crown rot	(Rhizoctonia bataticola)	10	25
Leaf scorch	(Diplocarpon earliana)	35	5

(1) Mathematical relationship between pest density and yield (if known):
Decayed fruit = 100% loss
Leaf spots = 30% loss to fruit size and quality

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicides required to control fruit decay pathogens; straw mulch used to protect berries from contact with soil; irrigation used to provide water to prevent moisture stress.

f. Alternative fungicides, formulations, rates:
captan 50WP 3.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to thiophanate methyl reported in several regions. Resistance development can be delayed by using in combination with chemically unrelated fungicides or by limiting the number of applications per season.

b. Management practices using no chemical pesticides: Annual removal or renovation of beds which destroys diseased parts; Raised beds eliminates flooding and encourages rapid drying. Use of resistant cultivars

c. Diseases without adequate controls
Red stele root rot and other root rots

FUNGICIDE BENEFITS REPORT

COMMODITY Strawberry (Fragaria virginiana) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 29,900 2. ACRES HARVESTED: 29,000

3. ACRES TREATED: 4,185 with 3-5 APPLICATIONS

4. FUNGICIDE thiram

a. Formulations: Thiram 65WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
thiram 65WP 20-26 oz	3-5	Bloom, Post-bloom at 10 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers 95% vs irrigation 5%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Gray mold	(Botrytis cinerea)	100	45
Leaf blight and crown rot	(Rhizoctonia bataticola)	10	25
Leaf scorch	(Diplocarpon earliana)	35	5
Leaf spot	(Mycosphaerella fragariae, Septiria fragariae)	35	20

(1) Mathematical relationship between pest density and yield (if known):
Decayed fruit = 100% loss
Leaf spots = 30% loss to fruit size and quality

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicides required to control fruit decay pathogens; straw mulch used to protect berries from contact with soil; irrigation used to provide water to prevent moisture stress.

f. Alternative fungicides, formulations, rates:
captan 50WP 3.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to thiram known.

b. Management practices using no chemical pesticides: Annual removal or renovation of beds which destroys diseased parts; Raised beds eliminates flooding and encourages rapid drying. Use of resistant cultivars

c. Diseases without adequate controls
Red stele root rot and other root rots

FUNGICIDE BENEFITS REPORT

COMMODITY Strawberry (Fragaria virginiana) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 29,900 2. ACRES HARVESTED: 29,000

3. ACRES TREATED: 20,925 with 1-3 APPLICATIONS

4. FUNGICIDE vinclozolin

a. Formulations: Ronilan 50WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Ronilan 50WP 12-16 oz	1-3	Bloom, Post-bloom at 7-14 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers 95% vs irrigation 5%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Gray mold	(Botrytis cinerea)	100	45

(1) Mathematical relationship between pest density and yield (if known):

Decayed fruit = 100% loss
Leaf spots = 30% loss to fruit size and quality

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicides required to control fruit decay pathogens; straw mulch used to protect berries from contact with soil; irrigation used to provide water to prevent moisture stress.

f. Alternative fungicides, formulations, rates:
captan 50WP 3.0 lb ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: Resistance to vinclozolin probable unless used in limited applications seasonally or in combination with chemically unrelated fungicides.

b. Management practices using no chemical pesticides: Annual removal or renovation of beds which destroys diseased parts; Raised beds eliminates flooding and encourages rapid drying. Use of resistant cultivars

c. Diseases without adequate controls
Red stele root rot and other root rots

FUNGICIDE BENEFITS REPORT

COMMODITY Strawberry (Fragaria virginiana) SUB-COMMODITY

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 29,900 2. ACRES HARVESTED: 29,000

3. ACRES TREATED: 1,400 with 3-4 APPLICATIONS

4. FUNGICIDE ziram

a. Formulations: Ziram F-4 41.5%

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Ziram F-4 41.5% 13-20 oz	3-4	Bloom and at 5-10 da intervals during Post-bloom

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Ground sprayers 95% vs irrigation 5%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Gray mold	(Botrytis cinerea)	100	45
Leaf blight and crown rot	(Rhizoctonia bataticola)	10	25
Leaf scorch	(Diplocarpon earliana)	35	5
Leaf spot	(Mycosphaerella fragariae, Septiria fragariae)	35	20

(1) Mathematical relationship between pest density and yield (if known):
Decayed fruit = 100% loss
Leaf spots = 30% loss to fruit size and quality

e. Normal (appropriate or typical) management practices using chemical and non-chemical control: Fungicides required to control fruit decay pathogens; straw mulch used to protect berries from contact with soil; irrigation used to provide water to prevent moisture stress.

f. Alternative fungicides, formulations, rates:
captan 50WP 3.0 lb ai/A; Thiram 65WP 20-26 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management: No resistance to ziram known

b. Management practices using no chemical pesticides: Annual removal or renovation of beds which destroys diseased parts; Raised beds eliminates flooding and encourages rapid drying. Use of resistant cultivars

c. Diseases without adequate controls
Red stele root rot and other root rots

Fungicide Benefits on PECAN (*Carya illinoensis*)

Commercial pecan production is located in the southeastern and southwestern states. Accurate statistics on acreage are lacking in most states because small plantings of a few trees are common and generally not treated as commercial, but often are harvested and sold. Estimated acreage in 11 southern states is 446,000 acres with an annual production of 278.8 million pounds (in-shell basis) valued at approximately $165 million (Table 10).

Pecans are affected by seven or eight fungal pathogens that can cause significant losses if not controlled. About 80% of the pecan acreage is treated with from 5-7 fungicide applications annually. Pecan scab is the most important disease which is found in most plantings and can cause up to 80% reduction in crop if not controlled. Small plantings and isolated trees that are not regularly treated have irregular crops due to sporadic severe scab years which often causes alternate bearing. The fungicides most commonly used for disease control include benomyl, dodine, thiophanate, triphenyltin hydroxide, fenarimol and propiconizol. Strains of the scab pathogen that are tolerant of benomyl, thiophanate methyl, and dodine have developed in some groves. It is recommended that these fungicides be used in combination with chemically unrelated protective fungicides in limited applications per season. The sterol-inhibitor fungicides fenarimol and propiconizol presently, have limited usage but are expected to be used more extensively in the future.

Table 10. Nut Bearing Acres and Production in United States in 1988.

State	Crop	Bearing Acres-1988	Production 1,000 lbs
California	Almonds	406,000	580,000
Total		406,000	580,000[1]
Oregon	Filberts	26,100	16,300
Washington	Filberts	400	200
Total		26,500	16,500[2]
California	Walnuts (English)	176,400	200,000
Total		176,400	200,000[2]
			1,000 lbs
Hawaii	Macadamia	16,600	47,000
Total		16,600	47,000[2]
California	Pistachios	44,500	92,000
Total		44,500	92,000[2]
Alabama	Pecans		11,000
Arkansas	Pecans		3,000
California 2/	Pecans		2,000
Florida	Pecans		5,800
Georgia	Pecans		110,000
Louisiana	Pecans		30,000
Mississippi	Pecans		13,000
New Mexico	Pecans		26,000
North Carolina	Pecans		3,500
Oklahoma	Pecans		27,000
South Carolina	Pecans		4,500
Texas	Pecans		43,000
Total			278,800[2]

[1] Shelled Basis
[2] In-shell Basis

FUNGICIDE BENEFITS REPORT

COMMODITY Pecan (Carya illinoensis) SUB-COMMODITY _____

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 446,000 2. ACRES HARVESTED: 425,000

3. ACRES TREATED: _____ with _____ APPLICATIONS

4. FUNGICIDE benomyl

a. Formulations: Benlate 50DF or 50WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Benlate 50DF 4-8 oz plus triphenyltin hydroxide 4.7 oz ai/A	4-6	Bud-break; when young fruit form, 3-4 wk intervals to shuck-split

c. Methods of application (% aerial coverage vs blower, irrigation, etc): airblast ground sprayer, 85%; aerial, 15%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown leafspot	(Cercospora fusca)		
Downy spot	(Mycosphaerella caryigena)		
Liver spot	(Gnomonia caryae pv. caryigena)		
Powdery mildew	(Microsphaera penicillata)		
Scab	(Cladosporium caryigenum)		
Fungal leaf scorch	(Cause unknown)		

(1) Mathematical relationship between pest density and yield (if known):

Scab - fruit drop and deformed - 80%
Leaf spots - less proportional to severity

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:

Seasonal fungicide usage is necessary in commercial production.

Some groves (20%) not treated but yield is variable.

f. Alternative fungicides, formulations, rates:

thiophanate methyl 6-12 oz ai/A plus unrelated companion fungicide

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management:

Tolerant strains of the scab pathogen to benomyl present in some groves. Alternations or combinations of the "at risk" fungicides with protective fungicides used. Avoid repeated applications.

b. Management practices using no chemical pesticides:

Weed and rodent control through mowing of weeds and grass

c. Diseases without adequate controls

FUNGICIDE BENEFITS REPORT

COMMODITY Pecan (Carya illinoensis) SUB-COMMODITY _____

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 446,000 2. ACRES HARVESTED: 425,000

3. ACRES TREATED: _____ with _____ APPLICATIONS

4. FUNGICIDE dodine

a. Formulations: Cyprex 65W

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Cyprex 65W 20-40 oz	6-7	Bud-break; 10-14 da int. thru 1st cover; Repeat at 2-3 wk intervals to shuck-split

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 85%; aerial, 15%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown leafspot	(Cercospora fusca)		
Downy spot	(Mycosphaerella caryigena)		
Liver spot	(Gnomonia caryae pv. caryigena)		
Scab	(Cladosporium caryigenum)		
Fungal leaf scorch	(Cause unknown)		

(1) Mathematical relationship between pest density and yield (if known):

Scab - fruit drop and deformed - 80%
Leaf spots - less proportional to severity

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:

Seasonal fungicide usage is necessary in commercial production. Some groves (20%) not treated but yield is variable.

f. Alternative fungicides, formulations, rates:

Benlate 50Df 4-8 oz ai/A plus a protectant (unrelated fungicide) triphenyltin hydroxide 4.7 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management:

Tolerant strains of the scab pathogen to dodine found in some groves - Do not use seasonal sprays of dodine alone.

b. Management practices using no chemical pesticides:

Weed and rodent control through mowing of weeds and grass

c. Diseases without adequate controls

FUNGICIDE BENEFITS REPORT

COMMODITY Pecan (Carya illinoensis) SUB-COMMODITY _____

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 446,000 2. ACRES HARVESTED: 425,000

3. ACRES TREATED: _____ with _____ APPLICATIONS

4. FUNGICIDE fenarimol

a. Formulations: Rubigan 1EC

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Rubigan 1EC 1.0-4.0 oz	2-3	Bud-break and repeat at 7-10 da intervals to when nuts are 1/2" long
Rubigan 1EC 1.0-4.0 oz + Protectant fungicide (TPTH, dodine, etc)	3-4	7-10 day intervals when nuts are longer than 1/2" until 30 days of harvest

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 85%; aerial, 15%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Powdery mildew	(Microsphaera penicillata)		
Scab	(Cladosporium caryigenum)		

(1) Mathematical relationship between pest density and yield (if known):

Scab - fruit drop and deformed - 80%
Leaf spots - less proportional to severity

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:

Seasonal fungicide usage is necessary in commercial production.

Some groves (20%) not treated but yield is variable.

f. Alternative fungicides, formulations, rates:

Orbit 3.6L 1.67 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management:

No resistance to fenarimol known to date.

b. Management practices using no chemical pesticides:

Weed and rodent control through mowing of weeds and grass

c. Diseases without adequate controls

FUNGICIDE BENEFITS REPORT

COMMODITY Pecan (Carya illinoensis) SUB-COMMODITY _____

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 446,000 2. ACRES HARVESTED: 425,000

3. ACRES TREATED: _____ with _____ APPLICATIONS

4. FUNGICIDE propiconizol

a. Formulations: Orbit 3.6L

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Orbit 3.6L 1.67 oz	3-4	Bud-break, when young fruit form, and at 14 da interv. to shuck-split (not more than 4 applic/season)

c. Methods of application (% aerial coverage vs blower, irrigation, etc): airblast ground sprayer, 85%; aerial, 15%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Downy spot	(Mycosphaerella caryigena)		
Liver spot	(Gnomonia caryae pv. caryigena)		
Scab	(Cladosporium caryigenum)		
Zonate leaf spot	(Cristalariella pyramidalis)		
Fungal leaf scorch	(Cause unknown)		

(1) Mathematical relationship between pest density and yield (if known):

Scab - fruit drop and deformed - 80%
Leaf spots - less proportional to severity

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:

Seasonal fungicide usage is necessary in commercial production. Some groves (20%) not treated but yield is variable.

f. Alternative fungicides, formulations, rates:

Rubigan 1E 1.0-4.0 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management:

No strains of pathogens tolerant to Orbit to date

b. Management practices using no chemical pesticides:

Weed and rodent control through mowing of weeds and grass

c. Diseases without adequate controls

FUNGICIDE BENEFITS REPORT

COMMODITY Pecan (Carya illinoensis) SUB-COMMODITY _____

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 446,000 2. ACRES HARVESTED: 425,000

3. ACRES TREATED: _____ with _____ APPLICATIONS

4. FUNGICIDE thiophanate methyl

a. Formulations: Topsin-M 70WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Topsin-M 70W 6-12 oz plus Triphenyltin hydroxide 4.7 oz ai/A	4-6	Bud-break; when young fruit form, 3-4 wk intervals to shuck-split

c. Methods of application (% aerial coverage vs blower, irrigation, etc): airblast ground sprayer, 85%; aerial, 15%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown leafspot	(Cercospora fusca)		
Downy spot	(Mycosphaerella caryigena)		
Powdery mildew	(Microsphaera penicillata)		
Scab	(Cladosporium caryigenum)		

(1) Mathematical relationship between pest density and yield (if known):

Scab - fruit drop and deformed - 80%
Leaf spots - less proportional to severity

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:

Seasonal fungicide usage is necessary in commercial production. Some groves (20%) not treated but yield is variable.

f. Alternative fungicides, formulations, rates:

Benlate 50DF 4-8 oz ai/A plus unrelated companion fungicide

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management:

Tolerant strains of the scab pathogen on Topsin-M present in some groves. Alternations or combinations of the "at risk" fungicides with protective fungicides used. Avoid repeated applications.

b. Management practices using no chemical pesticides:

Weed and rodent control through mowing of weeds and grass

c. Diseases without adequate controls

FUNGICIDE BENEFITS REPORT

COMMODITY Pecan (Carya illinoensis) SUB-COMMODITY _____

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 446,000 2. ACRES HARVESTED: 425,000

3. ACRES TREATED: _____ with _____ APPLICATIONS

4. FUNGICIDE triphenyltin hydroxide (TPTH)

a. Formulations: DU-Ter 30F; Super-Tin 4L; Triple Tin 4L

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Du-Ter 30F 4.7-9.5 oz	4-6	Bud-break; 14-day interv. to pollination; repeat at
or		
Super-Tin 4L 4.6-9.0 oz	4-6	2-4 wks as needed

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 85%; aerial, 15%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Brown leafspot	(Cercospora fusca)		
Downy spot	(Mycosphaerella caryigena)		
Liver spot	(Gnomonia caryae pv. caryigena)		
Scab	(Cladosporium caryigenum)		

(1) Mathematical relationship between pest density and yield (if known):

Scab - fruit drop and deformed - 80%
Leaf spots - less proportional to severity

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:

Seasonal fungicide usage is necessary in commercial production. Some groves (20%) not treated but yield is variable.

f. Alternative fungicides, formulations, rates:

Orbit 3.6L 1.67 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management:

TPTH is used in combination with benomyl or thiophanate methyl to prevent tolerant strain development to these fungicides.

b. Management practices using no chemical pesticides:

Weed and rodent control through mowing of weeds and grass

c. Diseases without adequate controls

FUNGICIDE BENEFITS REPORT

COMMODITY Pecan (Carya illinoensis) SUB-COMMODITY _____

GEOGRAPHIC PRODUCTION AREAS Eastern States

1. ACRES PLANTED: 446,000 2. ACRES HARVESTED: 425,000

3. ACRES TREATED: _____ with _____ APPLICATIONS

4. FUNGICIDE ziram

a. Formulations: Ziram 76WP

b. Federal/State recommendations or guidelines:

Fungicide, Form. Rate (ai/A)	No. of Applications	Timing range or avg.
Ziram 76WP 1.5-2.0 lb	4-5	When disease first appears, then at 21-28 da intervals

c. Methods of application (% aerial coverage vs blower, irrigation, etc): Airblast ground sprayer, 85%; aerial, 15%

d. Diseases subject to control:

Common Name	Causal Organism	% Acres Infected	% Yield Loss Without Control
Anthracnose	(Glomerella sp.)		

(1) Mathematical relationship between pest density and yield (if known):

Scab - fruit drop and deformed - 80%
Leaf spots - less proportional to severity

e. Normal (appropriate or typical) management practices using chemical and non-chemical control:

Seasonal fungicide usage is necessary in commercial production. Some groves (20%) not treated but yield is variable.

f. Alternative fungicides, formulations, rates:

DU-Ter 30F 4.7-9.5 oz ai/A

5. DISEASE MANAGEMENT STRATEGIES:

a. Resistance management:

No tolerance to ziram known.

b. Management practices using no chemical pesticides:

Weed and rodent control through mowing of weeds and grass

c. Diseases without adequate controls